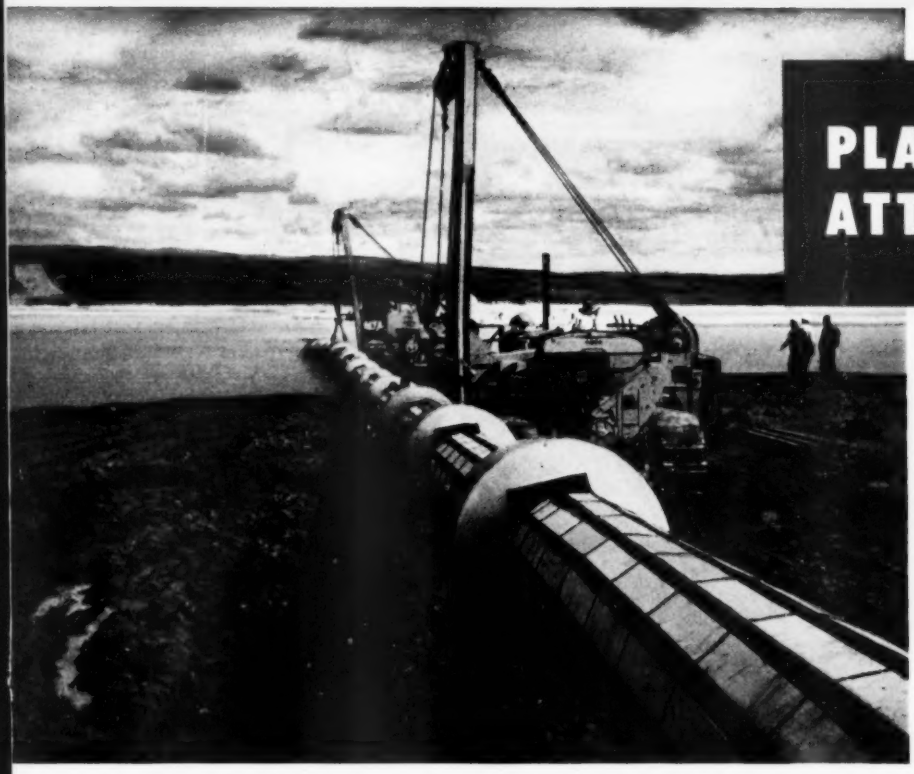
ANNUAL Pipe-Line NUMBER

L AND GAS JURNAL



PLANNED ATTACK

Come what may—river, mountain or desert—the pipe line goes ahead, meeting the tight schedule Bechtel sets.

Thorough planning, spreads engineered to fit job conditions and crack teams under experienced leadership are reasons why . . . ***Bechtel builds faster.***

BECHTEL CORPORATION

"BUILDERS FOR INDUSTRY"

Los Angeles • **SAN FRANCISCO** • *New York*

BECHTEL

• ENGINEERS

• CONSTRUCTORS

PRICE 50 CENTS TABLE OF CONTENTS PAGE 143 **OCTOBER 4, 1951**

ROCKWELL ORIFICE METERS

Take high pressures in stride

WITH NEW LEAKPROOF STUFFING BOX

When the pressure is *up*, it will pay you to use Rockwell orifice meters. They have the exclusive advantage of a revolutionary new stuffing box that prevents leakage troubles at this vulnerable point. The unit is self-lubricated, requires no maintenance. The higher the pressure, the tighter it seals—yet the shaft will freely rotate even under extreme conditions.

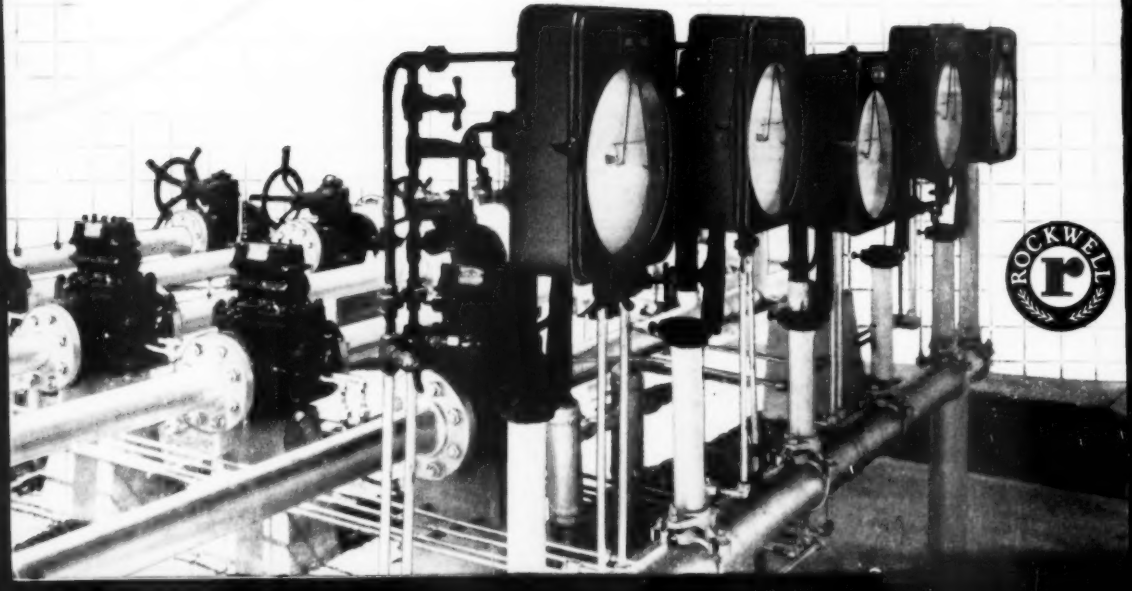
You'll get this new leakproof stuffing box *plus* forged steel chambers, unit manometer construction, positive inking pens and a host of other features in Rockwell orifice meters. For either high, low or intermediate pressures they are your best buy. Write for bulletin 1050.

Stuffing Box Details

This unit has a *combination packing and bearing* made of Teflon. The material is tough, chemically resistant, stands up to 400° F. and has a low coefficient of friction. Teflon flows slightly under pressure to adjust itself to the stuffing box body and the periphery of the shaft. It seals without binding! The spring loaded follower serves as a pilot to hold the Teflon in alignment. All other parts are stainless steel. Packaged stuffing box kits for converting meters in service are available.

ROCKWELL MANUFACTURING COMPANY
Pittsburgh 8, Pa.

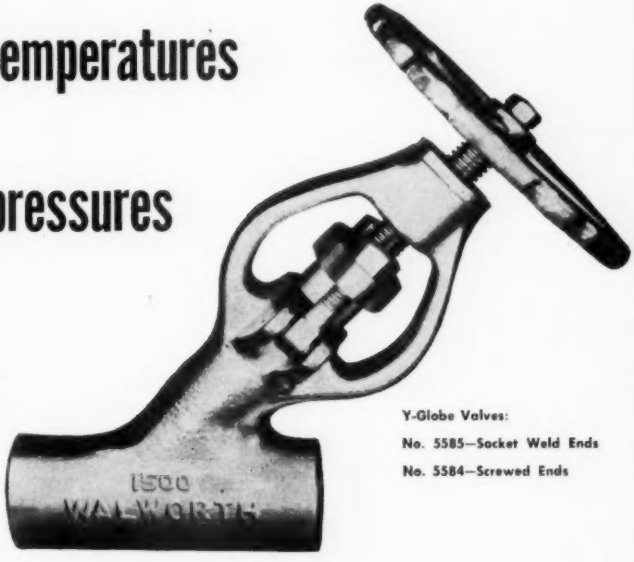
Atlanta • Boston • Chicago • Columbus • Houston
Kansas City • Los Angeles • New York • Pittsburgh
San Francisco • Seattle • Tulsa



Walworth's NEW small cast steel valves

SERIES 1500 – SIZES ¼ to 2 inches

handle HIGH temperatures
HIGH pressures



Y-Globe Valves:
No. 5585—Socket Weld Ends
No. 5584—Screwed Ends

Walworth is proud to make these new Small Cast Steel Valves available to power stations . . . oil refineries . . . ships . . . wherever piping is subject to severe pressures and temperatures. Non-shock service ratings of these valves: 1500 psi–950F for steam; 3600 psi–100F for water, oil or gas. Cast of chromium molybdenum steel, they are compact and light, yet exceptionally strong. Both Y-Globe and Angle type valves are available.

Angle Valves:
No. 5587—
Socket Weld End
No. 5586—
Screwed End

Simplified Walworth design eliminates many of the valve problems encountered in high pressure service. Among the features of this new valve are:

INTEGRAL BODY AND YOKE – made from a single casting without threading or welding. Bonnet joint — always a potential source of leakage — is eliminated. Valves can be reassembled quickly and easily.

ROTATING DISC – prevents valve seat distortion and consequent leakage. Cuts down replacements.

WELDED SEAT RING – compensates for changes in pressure and temperature—eliminates a major source of leakage.

SPECIAL BACK SEAT BUSHING – permits repacking the valve under pressure with greater safety.

PACKING CHAMBER – designed to dissipate heat thus keeping packing rings at lower temperatures—gives them longer life.

These valves are available with either socket weld ends or screwed ends, in sizes ranging from ¼ to 2 inches. For further information on Walworth series 1500 Small Cast Steel Valves, see your local Walworth distributor, or write for Circular No. 134.

WALWORTH

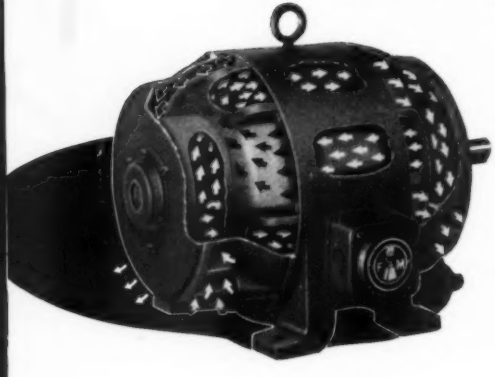
valves • fittings • pipe wrenches

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

The Oil and Gas Journal, published Thursdays by The Petroleum Publishing Company. Entered as second-class matter September 1, 1910 at post office at Tulsa, Okla., under act of March 3, 1879. U. S. and foreign rates to the petroleum industry, $3 yearly. Copyright 1951

We "Cooled Off" the Hot Spots for Longer Motor Life!



You'll find no hot spots in a Fairbanks-Morse Motor. Unique cross-flow ventilation assures uniform motor cooling . . . eliminates the hot spots that are so destructive to a stator insulation. Air is taken in at each end of the motor, flows through separated passageways across the stator core, and is exhausted simultaneously at opposite ends. This advantage is standard on all popular size Fairbanks-Morse General Purpose Motors.

Combine cross-flow ventilation with exclusive, indestructible Copperspun Rotors, protected, one-piece cast frame and rugged construction and you'll see why it pays to specify Fairbanks-Morse for your oil field motors. Fairbanks, Morse & Co., Chicago 5, Illinois.

FAIRBANKS-MORSE,
a name worth remembering

OIL FIELD EQUIPMENT • PUMPS • SCALES
ELECTRIC MOTORS • GENERATORS • LIGHT PLANTS • DIESEL, DUAL FUEL AND GASOLINE ENGINES • MAGNETOS

The Original Non-Slam Check Valve!

CUSHIONED against shock and impact

Shock-free closing regardless of line pressure . . . with positive shut-off assured by soft seats, or ground-and-lapped metal seating surfaces.

Proved in service on the oil and gas lines of over 25 major pipe line companies, SHMCO ***Non-Slam*** Check Valves are the **original** valves with enclosed and sealed hydraulic control units. Available in sizes from 4" through 30", SHMCO ***Non-Slam*** Check Valves have replaceable soft or metal seat rings, with metal-faced clapper. All sizes are full opening and are furnished in Series 150, 300 and 600.

For the utmost in pipe line protection, specify SHMCO ***Non-Slam*** Check Valves.

SHMCO ***Non-Slam*** Check Valves are designed for the toughest services. *Where conditions permit their use, SHMCO* ***Conventional*** *Check Valves are furnished in sizes from 2" through 30".*

SOUTH HOUSTON MACHINE COMPANY, INC.

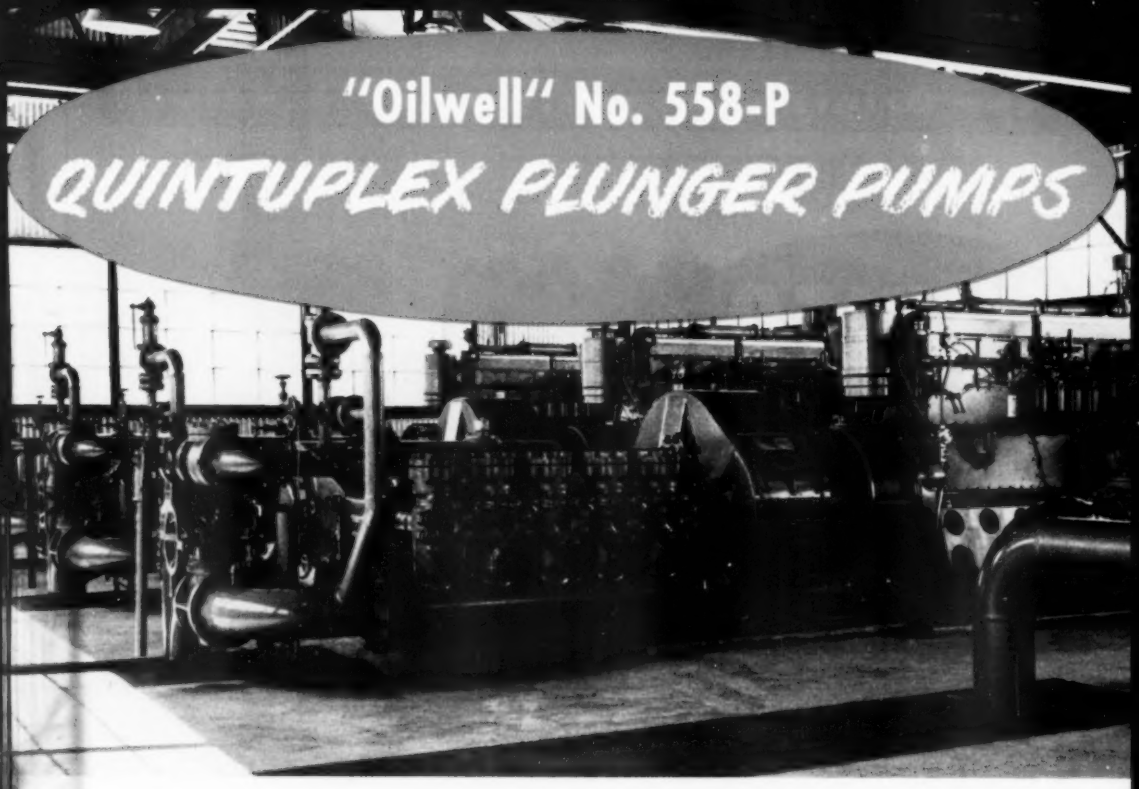
P. O. BOX 358 **SOUTH HOUSTON, TEXAS**

Exclusive Domestic Sales: SALES ENGINEERING CO. OF HOUSTON, INC., 2930 Pease Ave., Houston, Texas

Mexico: Ing. J. M. de la Garza C., Ave. Morelos No. 37, Mexico 1, D.F., Mex.

Canada: Import Tool Co., Ltd., 202 Barron Bldg., 8th Ave. West & Fifth St., Calgary, Alta., Canada

Manufacturers of SHMCO *Non-Slam Check Valves*



...PUMP HEAVY CRUDE

at Union Oil Company's Antelope Station near Avenal, California

THE PROBLEM confronting the pipe-line engineers of Union Oil Company in modernizing the company's Antelope Station and replacing the steam pumping equipment previously in service was:

1—**to pump 15-16 gravity crude oil through an 8-inch line in varying quantities to meet**

2—**flexible requirements which might vary from 9,600 to 25,920 barrels per day.**

THE SOLUTION was the installation of "Oilwell" No. 558-P heavy-duty quintuplex plunger pipe-line pumps, driven by diesel engines through suitable reduction gears. Each pump operates independently at 103-124 RPM ranges, to deliver from 450 to 540 Bbls h of this heavy crude at 800 PSIG. The crude is heated to 180°F. before pumping. The installation consists of three pump-engine hook-ups, with two pumps operating and the third as a standby.

ASK YOUR "OILWELL" REPRESENTATIVE to show you how the design of these quintuplex pumps makes them exceptionally suitable for pumping either heavy or volatile products . . . and get your copy of the new "Oilwell" Pipe Line Pump Booklet—No. 13-51.

OIL WELL SUPPLY COMPANY

Branches Serving All Oil Fields

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HOUSTON, TEXAS...TULSA, OKLAHOMA
LOS ANGELES, CALIFORNIA

USS TRADE MARK

"OILWELL" TRADE MARK

UNITED STATES STEEL

45 YEARS OF SERVICE TO OKLAHOMA

Since 1906, one year before statehood, Oklahoma Natural Gas Company has been both a participant and a spectator in the great industrial development that has transformed a virgin Indian Territory into an Industrial Empire important to the economic efficiency and security of the nation.

Strategically located in the heart of the Magic Empire, where a wide range of diversified raw materials and natural resources are abundant and native labor is plentiful and skilled, Oklahoma is the ideal location for industrial development.

Oklahoma Natural, through the years, has grown with Oklahoma; has constantly expanded its facilities and production to serve the commercial, industrial and domestic needs in more than 100 communities.

To more adequately balance supply with demand, both to serve growing industry and meet increased demands, Oklahoma Natural's gigantic underground storages coupled with over 5,600 miles of pipe lines enable the company to store safely large amounts of distress gas which otherwise would be wasted to the open air. Thus, Oklahoma Natural assures its customers an adequate supply of dependable natural gas to meet emergency and peak demands 365 days a year.

OKLAHOMA NATURAL
Gas Company

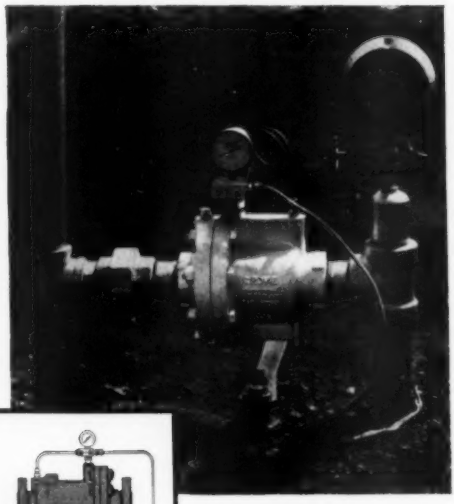
General Office **TULSA, OKLAHOMA**

For back pressure and relief services in the field —

Expansible tube type regulators are more reliable — need less attention

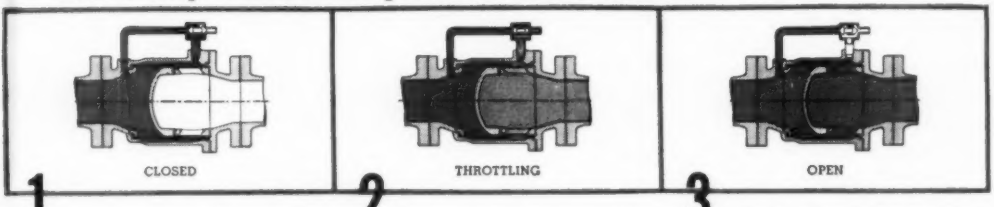
Dependability is the main requirement in oil field regulator installations where constant inspection and maintenance are impractical. Stemless, springless Flexflos have *no* metallic moving parts to corrode, stick, or wedge. No stuffing boxes to leak or freeze. Flexflos cannot fail to close perfectly with bubble-tight shut-off despite foreign particles or minor wear. Flexflos are instantly responsive to the slightest pressure variations. Action is smooth and rolling with no damaging slam or chatter.

All these important features add up to reliability. Maintenance-free performance you can count on day in, day out. Longer life under the most punishing field conditions. See below how Flexflo's simple operating principle can increase your regulator efficiency; reduce costly breakdowns and eliminate shop overhauls.



A Model 888 Grove Flexflo Reliever on Separator Gas Line. Pressure loaded operating cylinder is ground insulated against ambient temperature changes.

Here's why: *flexflo* lets pressure do the work--



1 The only moving part in the Flexflo Valve is a tough Buna N tube stretched over a cylindrical slotted metal core. When closed, line pressure from within, tending to force tube off core, is opposed by equal jacket pressure. Tension of the tube itself forms a positive, bubble-tight seal. The tube conforms to uneven surfaces and is hence unaffected by foreign matter or erosive wear.

2 As jacket pressure is reduced, line pressure begins to roll the tube off the core, opening the valve. Throttling is smooth and even. The Flexflo reacts instantly to the slightest pressure variations, compensating automatically for surge or shock impulses. Stability at all flow positions is accurately maintained. Fluttering and chattering are reduced to a minimum.

3 When all jacket pressure is removed, the tube is forced completely off the core and the valve assumes its wide open position. Full flow capacity with minimum pressure drop is assured. As Flexflo employs no hinge-pins, guides or other metallic moving parts, no troublesome problems of corrosion or wear are encountered. It cannot stick, wedge or slam.

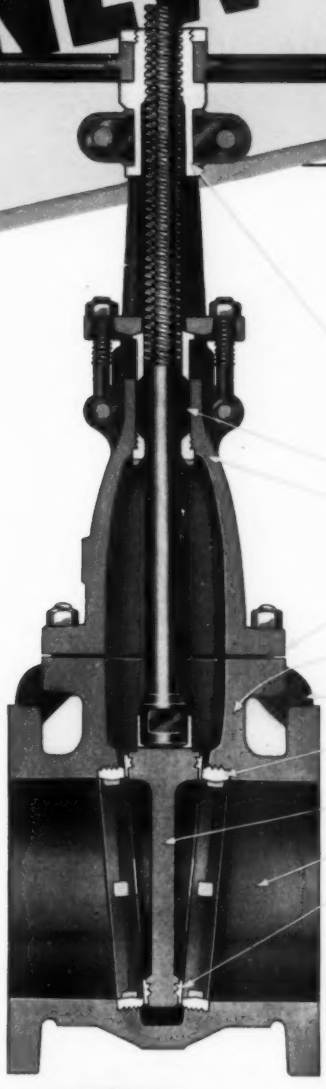
GROVE

Grove Flexflo Valves and Regulators are adaptable to air, gas, oil, water and other fluids at temperatures to 150° F. Available in iron or steel, sizes 1" to 12", for working pressures up to 1500 psi. Wire or write for full details.

***flexflo* VALVES and REGULATORS**

GROVE REGULATOR CO. 1333 SEVENTH STREET, OAKLAND 8, CALIFORNIA
1333 CALUMET, HOUSTON 4, TEXAS • 370 EAST 148TH ST., NEW YORK 51, N. Y.

NEW . . . a completely redesigned line of IRON VALVES by OIC



NOW the workhorse of the family—OIC's iron valve—offers you features formerly found only in steel valves. It's a brand new valve built around more than a third of a century's experience in making iron valves. We kept only the old handwheel.

Examine these construction details:

1. Lubricated yoke bushing, renewable without removing bonnet.
2. Deeper stuffing box; longer packing life.
3. Inserted back seat bushing permits repacking under full pressure.
4. Stronger body-bonnet joint; uniform gasket compression.
5. Better metal distribution, reduced weight, increased strength.
6. Sturdy tie-ribs; added resistance to pipeline stresses.
7. End-seated bronze seat rings will not loosen in service.
8. I-Beam type solid wedge, accurately guided.
9. Straight-through port areas reduce flow resistance
10. Rolled-in seat facings on wedges give longer life.

OIC's new line of Iron Valves gives you longer service, lower upkeep and greater security. For Bulletin 805 telling you all about them, call your local OIC distributor or write The Ohio Injector Company, Wadsworth, Ohio.

OIC
FOUNDED 1883

VALVES

FORGED AND CAST STEEL · IRON · BRONZE

Yes, we're *always* on the lookout for Pipe Line Progress . . . and here's ANOTHER Midwestern FIRST

Yes, a pipeline OUTER WRAP made from Fiberglas. Several years ago Midwestern and Owens-Corning brought out the first Fiberglas Inner Wrap for reinforcing your coatings. Now, through our combined efforts in seeking "Progress on the Line" we again lead the field in offering this exceptional new product that gives greatly increased corrosion protection at an extremely nominal cost. This amazing new outer wrap is designed to act as an exterior protection for underground pipe line. Composed of asphalted compound with tar additives the material is reinforced in a longitudinal direction by glass fiber mat and strong Fiberglas yarn. The product helps to prevent damage to enamel during lowering-in and back-filling operations and is partcularly valuable in off-setting soil stresses. The high porosity of Fiberglas Outer Wrap reduces holidays by permitting the complete release of trapped gasses and air.

THE BENEFITS OF A FIBERGLAS REINFORCING AND AN OUTSIDE WRAP IN ONE PACKAGE.

TENSILE STRENGTH—By the use of parallel Fiberglas yarns the tensile strength is greatly increased eliminating breakage.

NON-WICKING — Bitumen-and-glass construction eliminates all moisture wicking action. Will not draw protective fractions of enamel.

EASILY APPLIED—Fiberglas Outer Wrap will apply snugly around any bend.

STORAGE—Fiberglas Outer Wrap will withstand storage temperatures from 0° to 150° F. without deterioration.

BONDING — This Outer Wrap does more than bond . . . it fuses to the enamel becoming a permanent part of the coating.

HIGH MOISTURE RESISTANCE—Moisture absorption is less than one half of one percent.

A PROVEN PRODUCT — Fiberglas Outer Wrap, distributed by the Midwestern Engine and Equipment Company has been accepted by many of the largest companies in both natural gas and crude products transmission lines.

MIDWESTERN ENGINE & EQUIPMENT CO., INC.

105 N. Boulder — TULSA, OKLAHOMA — Phone 3-4113
15 S.W. 29th St. — OKLAHOMA CITY, OKLAHOMA — Phone 2-2527

HOUSTON, TEX — D. E. HUGHES — 5030 Arvilla Lane — Olive 1095

PITTSBURGH, PA. — JOHN R. WILSON — 555 McCulley, McKeesport, Pa. — McK 2-5461

SHREVEPORT, LA. — TOM L. HOLCOMBE — Box 1306, Shreveport — 7-0584

ATLANTA, GA. — RAYMOND TRAPP — 3431 Sherman Rd., Hapeville, Ga. — Calhoun 7929

POSITIVE PROTECTION AGAINST CORROSION

You can line up to 5 miles of pipe in place with RESOWELD

UNDERGROUND pipe lines up to 5 miles long can be coated *in place* with RESOWELD—Goodyear's lining material especially developed by the G.T.M. —Goodyear Technical Man—for oil field use. And look at the results you can expect!

Unlined metal piping handling sour West Texas crudes failed in 18 to 24 months.

RESOWELD *coated pipes in service 34 months to date — should be good for 5-7 years' minimum service.*

Results like this with highly corrosive crudes indicate that RESOWELD is your best buy for protection of your metal equipment. Ask the G.T.M. for details, or write Goodyear, Akron 16, Ohio.

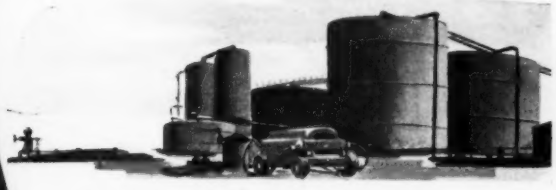
GOODYEAR INDUSTRIAL RUBBER PRODUCTS

GT-Specified

APPLICATIONS for RESOWELD

Pipe Lines—coated in place up to 5 miles in length
Tanks—oil storage
Christmas Trees
Steel Hulls of Tankers and Barges
Substructures and superstructures of offshore rigs—

AND WHEREVER CORROSION OF METAL SURFACES EXISTS



FOR HOSE, FLAT BELTS, V-BELTS, MOLDED GOODS, PACKING, TANK LINING, RUBBER-COVERED ROLLS *built to the world's highest standard of quality, phone your nearest Goodyear Industrial Rubber Products Distributor.*

GOODYEAR

THE GREATEST NAME IN RUBBER

We think you'll like "THE GREATEST STORY EVER TOLD"—Every Sunday—ABC Network

Resoweld—T.M. The Goodyear Tire & Rubber Company, Akron, Ohio

Pipeline on the March

... And a fast-stepping "march" it is with "Caterpillar" equipment in command. Just the kind of equipment that's needed to speed projects directly or indirectly associated with the national defense! To supply both rearmament and civilian activities with natural gas, the final section of the big "Super Inch" is here seen approaching its terminus near Llanada, California. With military unison, three "Cat" D8 Tractors put long stretches of welded pipe to bed – fast but gently. Of course they're outfitted with the right gear for such work. Offset track, plus added counterweighting, puts mighty lifting-and-lowering capacity into their Trackson Pipe Layers.

Because the work is tough, varied – and ceaseless around the clock – "Caterpillar" equipment has figured in the construction of most of the estimated 17,000 miles of pipeline laid in '51. It is widely preferred because (1) "Cat" machines can handle so many pipeline jobs – in clearing right of way, ditching, stabbing, welding, wrapping, doping, lowering, backfilling, cleaning up; (2) because they STAND UP under all kinds of punishment; and (3) because there is always within reach a "Caterpillar" dealer rich in experience and facilities for keeping them on the job. So, while governmental emergency demands come first –

Take your maintenance problems to your "Caterpillar" dealer* BEFORE *parts are worn beyond repair

He can build up track grousers, rerim sprockets, turn track pins and rollers for new wearing surfaces, refinish cylinder liners and crankshafts, recondition pistons, cylinder heads, radiators – salvage many other parts that will keep your machines operating dependably and lengthen their life.

CATERPILLAR, PEORIA, ILLINOIS

You're the Doctor

Good care is good medicine—for man or machine

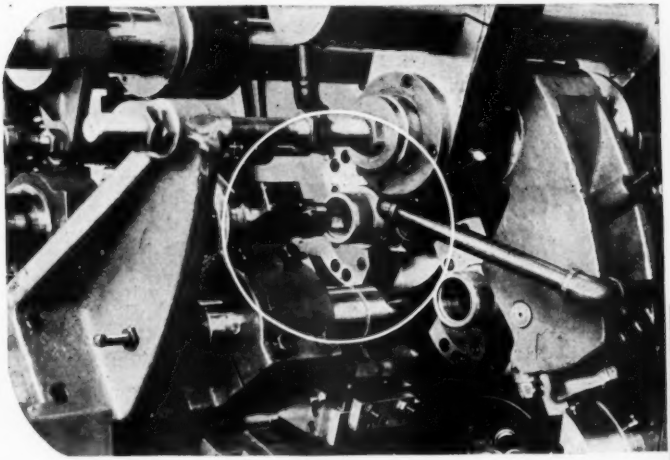
CAREFUL LUBRICATION practices, for instance, will add much to your satisfaction through equipment performance, economy and long life. Use only recommended lubricants, changing the lubricant at proper intervals . . . and use *only* "Caterpillar"-proved filter elements. Remove dirt from fittings and clean around crankcase filler cap before adding oil. A little care saves many hours of engine life. *Consult the Lubrication Chart in your Operator's Instruction Book.* AND REREAD THE BOOK OFTEN.

CATERPILLAR

REG. U. S. PAT. OFF.

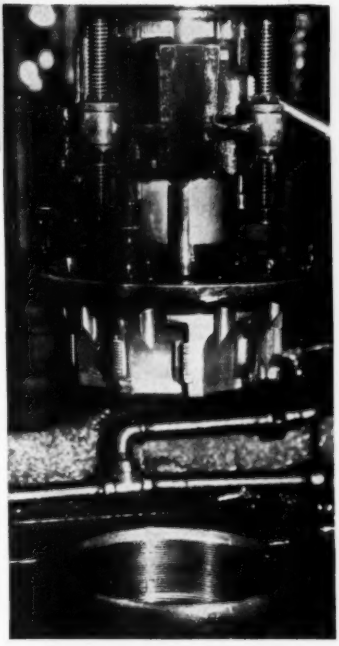
DIESEL ENGINES • TRACTORS • MOTOR GRADERS • EARTHMOVING EQUIPMENT

MANY THREAD DIAMETERS
WITH ONE LANDIS TAP



Detachable Heads Cut Wide Range of Internal Threads

The LANDIS Collapsible Tap is a many-purpose tool—yet a single-purpose tool. The versatility of the LANDIS Tap enables it to handle a wide variety of jobs—yet it handles each job as though it were a specially-designed tool.



WIDE THREAD CAPACITY

The ability to cut thread diameters of varying sizes is an outstanding feature of all LANDIS Taps. The thread-cutting head is detachable and tap heads of various sizes and capacities can be used interchangeably on the same tap body. This design makes it possible to cut an unusually-wide range of internal thread sizes with a minimum tool investment. For instance, the 5ALT Tap will cut threads from 1⅜" to 6⅝" in diameter.

EASY REMOVAL FROM WORK

LANDIS Taps are constructed with a built-in **collapsing** action. Chasers drop free from the work into the tap head at the completion of the thread. The tap can be removed directly without "backing out," thus saving labor time and chaser wear, and reducing the number of torn threads.

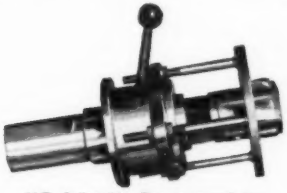
INTERNAL TAPERED THREADS

LANDIS Taps are of two types—the ALT for parallel threads—and the LL for tapered threads. The LL Receding Chaser Collapsible Tap is especially designed to cut API Standard threads in any machineable material well within all required tolerances. This tap features a new receding action—a fulcrumed lever—which gives a positive receding movement to the chasers and allows precision thread tapers. The low cutting strains thus obtained lengthen chaser life and improve thread accuracy and finish.

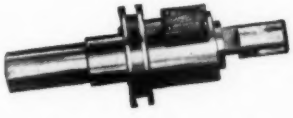
GENERAL FEATURES

LANDIS Taps can be used as stationary or rotary taps, and can be quickly converted from one type to the other. Left-hand threads may be cut with the same tap bodies, using left-hand tap heads. All taps have a fine size adjustment which allows compensation for wear and regrinding, and the style LL Tap can be adjusted to compensate for slight errors in taper.

Consider the money-saving features of LANDIS Taps in cutting internal threads in your plant. Write for Bulletins G-94 and G-95.



ALT Collapsible Tap arranged for use as a Stationary Tap.



LL Receding Chaser Collapsible Tap arranged for use as a **Rotary Tap.**

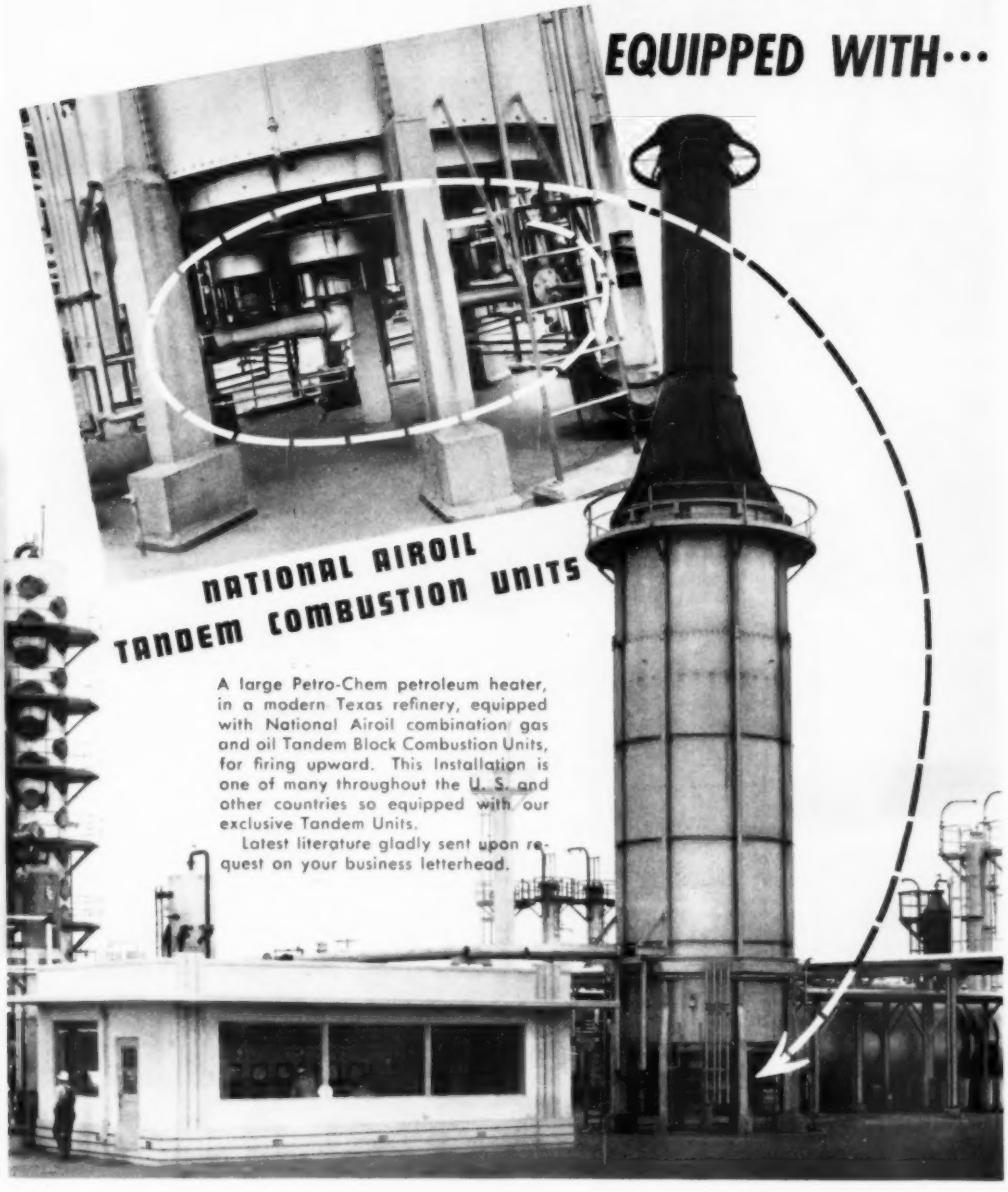
LANDIS MACHINE COMPANY

WAYNESBORO • PENNSYLVANIA

THREADING MACHINERY—THREAD CUTTING DIE HEADS—COLLAPSIBLE TAPS

Represented in the Domestic Oil Fields by: **Colcord-Wright Machinery & Supply Co., St. Louis, Mo.; C. J. Harter Machinery, Houston, Texas; Frederic-Baker Co., New Orleans, La.; Moore Machinery Co., Los Angeles and San Francisco, Calif.; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.**

EQUIPPED WITH···



NATIONAL AIROIL TANDEM COMBUSTION UNITS

A large Petro-Chem petroleum heater, in a modern Texas refinery, equipped with National Airoil combination gas and oil Tandem Block Combustion Units, for firing upward. This installation is one of many throughout the U. S. and other countries so equipped with our exclusive Tandem Units.

Latest literature gladly sent upon request on your business letterhead.

CHEMICAL-PETROLEUM DIVISION

NATIONAL AIROIL BURNER CO., INC.

Main Offices & Factory: 1236 EAST SEDGLEY AVENUE, PHILADELPHIA 34, PA.

Southwestern Division: 2512 South Boulevard, Houston 6, Texas

INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

"For today and for the future..."

THEODORE E. MUELLER

President, American Radiator
and Standard Sanitary Company

"For today and for the future: for yourself and for your country; the Payroll Savings Plan is a thoroughly American plan. By helping ourselves through savings we maintain and extend individual independence and help our country preserve its freedom. Thousands at American-Standard are carrying forward this sound American tradition of national-help through self-help."

". . . national-help through self-help"—that's the Payroll Savings Plan!

Introduced in 1941 and offered to millions of employees by alert managements, the Payroll Savings Plan has given employed men and women an easy, automatic way to build financial independence, save for a home, educate their children and gain many benefits that can be acquired only by thrift. It has built up a tremendous reserve of purchasing power: today, Americans hold more than $53 billion in U. S. Savings Bonds. It has helped to provide cash to retire maturing Savings Bond issues and pay off $6 billion in bankheld debt. It is one of our strongest checks on inflationary tendencies.

In these critical days, when "Defense is Everybody's Job" the Payroll Savings Plan is up front with America's defenders. Month after month, in upwards of 21,000 companies, more than 8,000,000 men and women are building a bulwark of thrift dollars. In January, 1951, 3,587,000 $25 Defense Bonds and 1,023,000 $50 Defense Bonds were purchased—the majority by serious savers on the Payroll Savings Plan.

Management is doing its part—in a big way. Hundreds of companies, large and small, are reinstating the Payroll Savings Plan or vitalizing the existing plan by a person-to-person canvass that puts a Payroll Savings Application Blank in the hands of every employee. No pressure is exerted—or needed. In Mr. Mueller's American-Standard plants, for example, the person-to-person canvass added 7,800 more employees to the plan that protects.

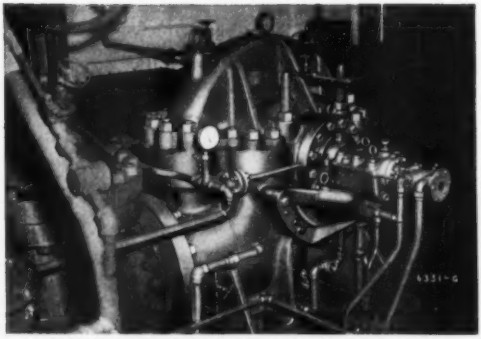
If your company does not have a Payroll Savings Plan . . . or if you have not made a person-to-person canvass recently . . . phone, wire or write to Savings Bond Division, U. S. Treasury Department, Suite 700, Washington Building, Washington, D. C. Your State Director will be glad to help you.

The U. S. Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the Advertising Council and

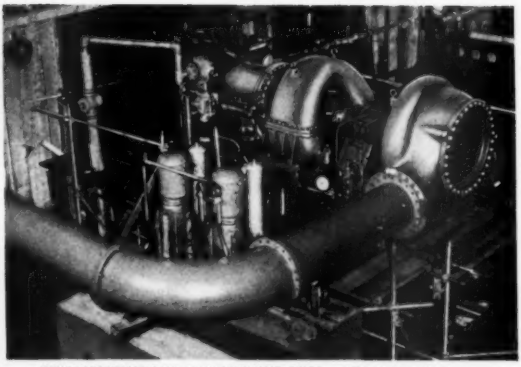
THE OIL AND GAS JOURNAL
TULSA 1, OKLAHOMA

DE LAVAL CENTRIFUGAL COMPRESSORS

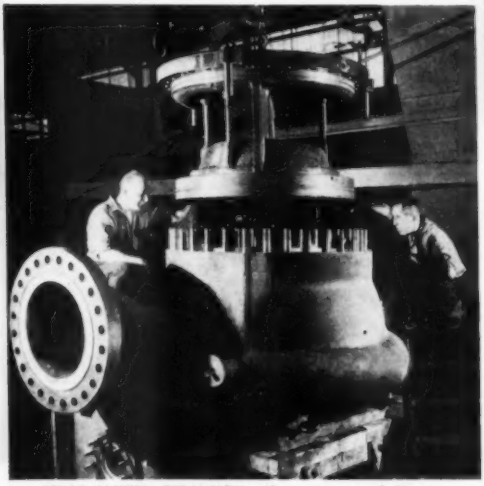
On All 4



TEXAS EASTERN TRANSMISSION CORP. — Here is one of the many De Laval motor-driven centrifugal compressors originally installed on the Big and Little Inch pipelines.



TRANSCONTINENTAL GAS PIPE LINE CORP. — This is the first steam turbine-driven compressor to go in service. Two other De Laval 5,000 hp units have been installed at station 7, McComb, Miss.



TEXAS EASTERN EXPANSION — Shown is one of 13 new De Laval motor-driven centrifugal compressors being built for Texas Eastern's expansion program.

On Order

EL PASO NATURAL GAS CO. — Two 5,000 hp gas turbine-driven De Laval centrifugal compressors are currently on order for El Paso's 26 and 30-inch natural gas pipelines.

Performance records of De Laval centrifugal compressors, used to transmit high pressure gas, have been outstanding. Leakage past the shaft seals has been zero, consumption of sealing oil insignificant and efficiency guarantees have been more than met. These and other important advantages are due to the basic simplicity of the De Laval design.

If a careful study of your needs indicates that centrifugal compressors are practical from an economic standpoint, it will pay you to consult our Field Engineer. He will give you the benefit of our experience on all four major pipelines.

50th Anniversary

DE LAVAL *Centrifugal Compressors*

DE LAVAL STEAM TURBINE COMPANY • TRENTON 2, NEW JERSEY

DL-119

WHY *Standardize* ON TRACKSON Pipe Layers!

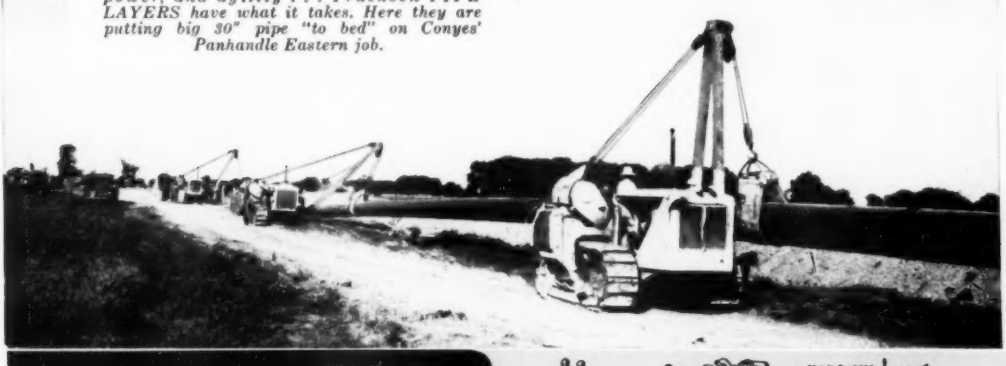
When you've been in the business as long as R. A. (Bob) Conyes, you know equipment. Conyes is one of the pioneers of the pipeline industry and he's seen and tried about every kind and make of equipment, but he sticks by his TRACKSON-CATERPILLAR teams. "They're working long after other units are worn out," Bob reports. The Conyes Construction Corp. spreads are now at work on a 130-mile section of 30-inch pipe between Tuscola, Ill., and Zionsville, Ind., for Panhandle Eastern Pipeline Co. Fourteen MD8's and ten MD7's are at work on the two spreads . . . stringing, priming, doping and wrapping, and lowering-in. Their fast, versatile power permits their use all along the line.

Take a tip from a veteran of many tough pipeline jobs . . . standardize on ruggedly-built Trackson PIPE LAYERS (there are five sizes) on all your spreads. Your TRACKSON-CATERPILLAR Dealer can help you . . . or write TRACKSON COMPANY, Dept. OG-101, Milwaukee 1, Wisconsin.

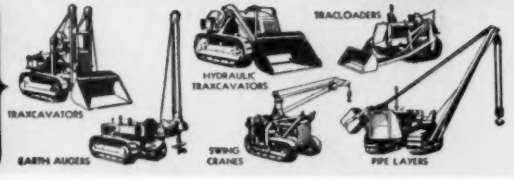
Cradling 30" pipe for the doping-wrapping gang on job which Conyes Construction Corp. is laying for Panhandle Eastern Pipeline Co.

Fast-acting MD8, with its D8 Tractor teammate, handling heavy pipe clamps and multitudes of other tough lifting jobs any place along the line.

Lowering-in calls for positive control, ample power, and agility . . . Trackson PIPE LAYERS have what it takes. Here they are putting big 30" pipe "to bed" on Conyes' Panhandle Eastern job.



TRACKSON
TRACTOR EQUIPMENT



Blueprint for IDEAL Plunger Lift Productivity

National Supply's new IDEAL Type F Plunger Lift affords maximum productivity at low initial and operating cost, with no depth limit. The Type F Plunger Lift operates on low gas pressure, and is not affected by crooked holes.

In the Type F Plunger Lift, National Supply provides these major improvements:

- **EXPANDING PLUNGER** operates in standard API tubing.
- **CAM-OPERATED PILOT VALVE** assures proper flow line closing after each plunger trip, saving gas energy.
- **IMPROVED CYCLE CONTROLLER** —Type C-1—affords precise and simple control, completely from the surface.

The effective IDEAL Plunger Lift utilizes the entire tubing length as a cylinder, with the plunger-piston traveling the full length at each stroke. Efficiency and economy of oil production is provided, particularly for wells with tight sands, and for deep wells.

Visit your nearby National Supply Store to get details on the features and ease of operation of the IDEAL Type F Plunger Lift.

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THE NATIONAL SUPPLY COMPANY

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Division Offices: Casper; Ft. Worth; Houston; Pittsburgh; Tulsa; Torrance
Canada: The National Supply Company, Ltd., 702 Barron Bldg., 610 Eighth Ave., West, Calgary, Alberta
Export: National Supply Export Corporation, 600 Fifth Avenue, New York 20, N.Y., U.S.A.; River Plate House 12 South Place, London E.C. 2

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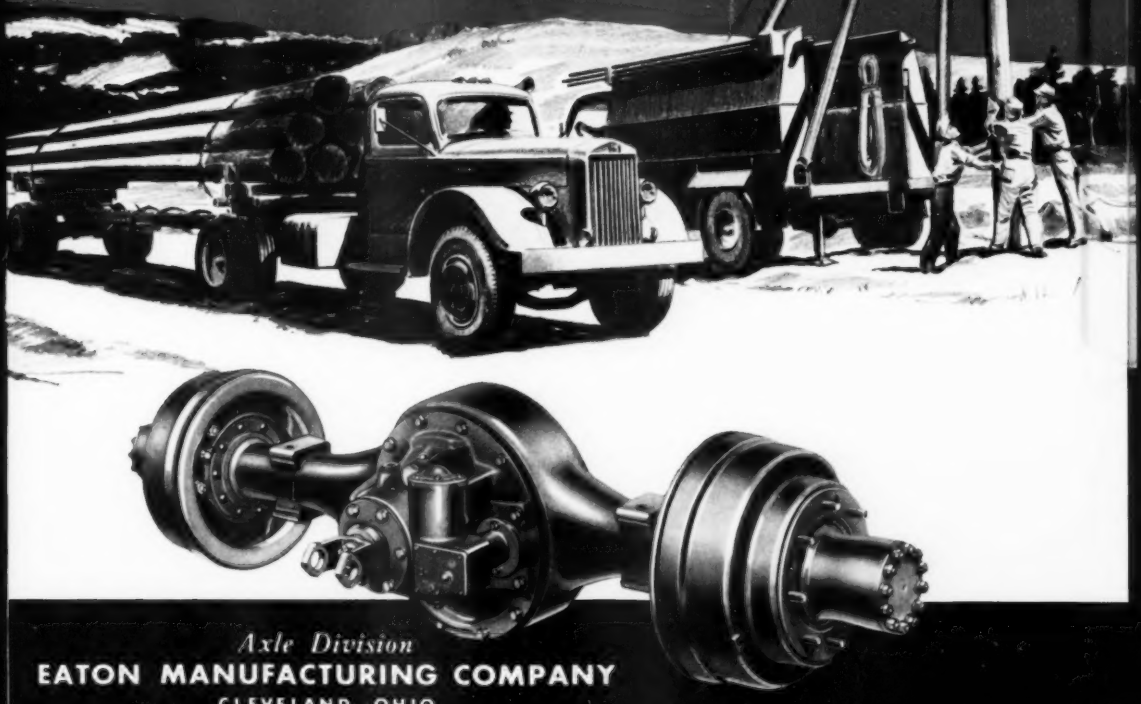
Trucks Go Faster at Lower Cost

Eaton 2-Speed Axles enable your trucks to go where they have to go to do the job—without damaging strain on engine and power-transmitting parts. They add to the performance of your vehicles, enable them to cover more payload miles in less time, at lower over-all cost. The experience of thousands of users proves that Eaton 2-Speed Axles and Eaton-equipped trucks last longer. Your truck dealer will explain how such outstanding Eaton features as planetary gearing and forced-flow lubrication add thousands of miles to axle life, save maintenance cost, reduce time-in-the-shop.

EATON
2-Speed Truck
AXLES



Axle Division

EATON MANUFACTURING COMPANY

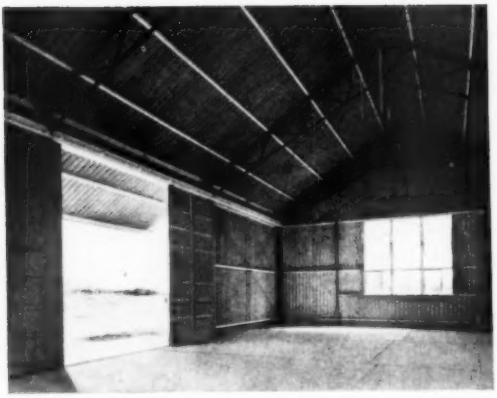
CLEVELAND, OHIO

EATON

PRODUCTS: SODIUM COOLED, POPPET, AND FREE VALVES • TAPPETS • HYDRAULIC VALVE LIFTERS • VALVE SEAT INSERTS • JET ENGINE PARTS • ROTOR PUMPS • MOTOR TRUCK AXLES • PERMANENT MOLD GRAY IRON CASTINGS • HEATER-DEFROSTER UNITS • SNAP RINGS SPRINGTITES • SPRING WASHERS • COLD DRAWN STEEL • STAMPINGS • LEAF AND COIL SPRINGS • DYNAMATIC DRIVES, BRAKES, DYNAMOMETERS

ARCON

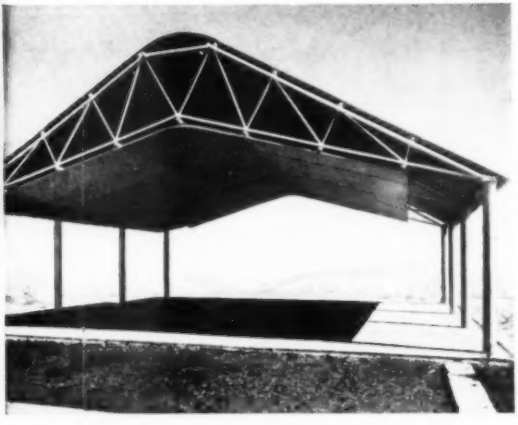
SERVES THE OIL INDUSTRY BY PROVIDING BUILDINGS FOR ALL PURPOSES



ARCON STORAGE BUILDING

This complete building by Arcon is ideal for stores, workshops and a big variety of other needs in the Oil Industry. Its unit design makes the finished structure very easy to extend or modify when necessary. The Arcon Storage Building is available in spans (single or multiple) of 33' 4" or 50' 0", with bays of 16' 8" and column heights of 10' 6" or 14' 6".

"BUILDINGS BY ARCON"— A phrase known all over the world and particularly by the oil industry in Iran, Iraq, Kuwait, Borneo, West Africa, French Somaliland, The West Indies and South America. With increasing production we are now able to offer these buildings in the American Market.



ARCON ROOF

The Arcon Roof Unit is a clever answer to accommodation needs in areas where cheap walling materials are readily obtainable, for its full weight is carried by its columns and the walls take no stress whatsoever. If preferred, the Arcon Roof Unit can be used as an open-sided building. We supply Arcon roofing in single or multiple spans of 30' 0", with 10' 0" bays and column heights of 9' 0" or 15' 0".

WRITE TO THE EXPORTERS :—

TAYLOR WOODROW
(BUILDING EXPORTS) **LTD.,**
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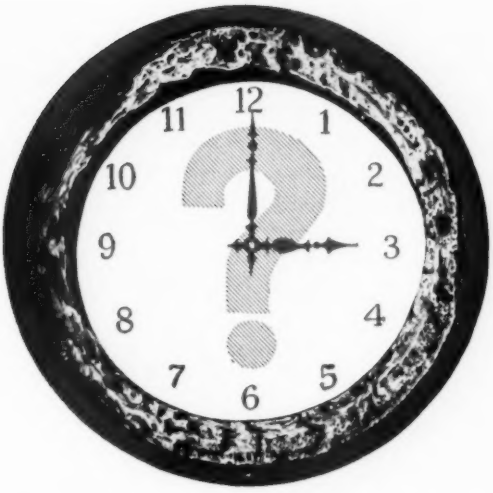
CABLES : TROPROOF, LONDON

FOR FULLY ILLUSTRATED BOOKLET



What Time This Month Will Boiler Tube Deposits Shut Down Your Plant?

It can happen *any day . . . any minute.* Deposits may be forming in your boiler tubes *right now* . . . adding layer on layer . . . building up for the failure that is sure to come!

When it does come, you can be sure of one thing. It's going to be expensive! Not only will replacement and installation costs be higher, but you'll also lose valuable production time. And unless your deposit problems are solved, it can happen again and again!

Drew Water Treatment will prevent the formation of deposits. Drew Service protects boilers and power plant equipment with a 3-point program that works! Here's what it does:

1. Drew engineers make a thorough study of plant operations and water problems.
2. Drew water chemists and engineers analyze this data in the modern Drew Laboratories and make specific recommendations for treatment.
3. Drew engineers make periodic service calls at your plant to insure the efficient and economical performance of your water conditioning.

Thoroughness of investigation, proper treatment and frequent service have made Drew one of America's fastest growing water treatment companies. Industry's most respected names avail themselves of Drew Boiler Water Treatment and Service. Do the same. Consult the nearest Drew engineer or write for information.

Send for new illustrated DREW ORGANICS folder describing the use of organics in modern boiler water treatment. Write today

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Power Chemicals Division

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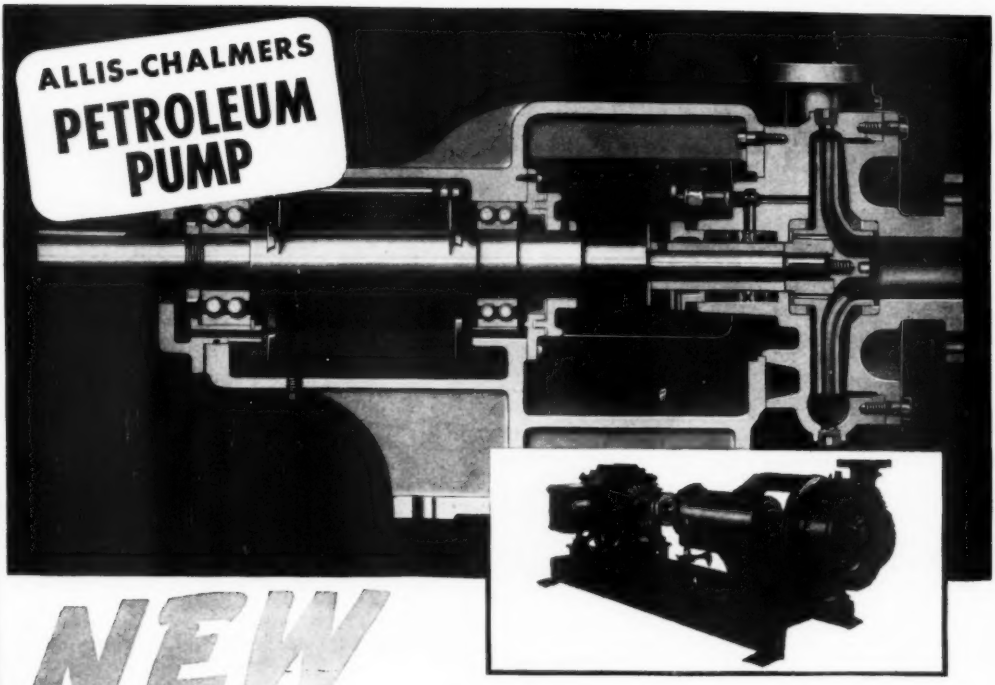

NEW

Specially Designed for Processing Operations

★ Choice of Materials
★ Oil Lubricated Bearings
★ Temperatures to 500° F.
★ Sizes to 1200 GPM, 250 Ft Head
★ Stuffing Box or Mechanical Seal

LONG LIFE, high efficiency, easy maintenance; you get them all from this new Allis-Chalmers Petroleum Pump. A wide choice of materials plus application engineering by men who know how to select the right material for your job means longest possible parts life and low maintenance costs no matter what you pump.

There is plenty of room between pump and pedestal for easy maintenance but rigidity has not been sacrificed. Maximum interchangeability of parts between sizes keeps parts inventory low.

ONE DEPENDABLE SOURCE

Allis-Chalmers can supply you with a complete pumping unit—pump, motor, drive and control — all of coordinated design and manufacture and all mounted on a rigid base ready to install.

To get more information on this new Allis-Chalmers Petroleum Pump, call your Allis-Chalmers Authorized Distributor or District Office. Or write to Allis-Chalmers, Milwaukee 1, Wis. for Bulletin 52B7638.

A-3459

Texrope and *Vari-Pitch* are Allis-Chalmers trademarks.

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Applied . . .
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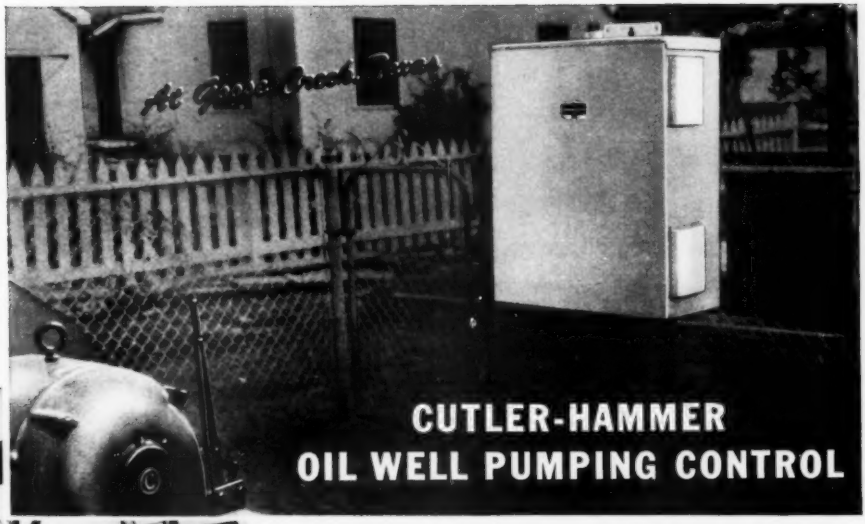
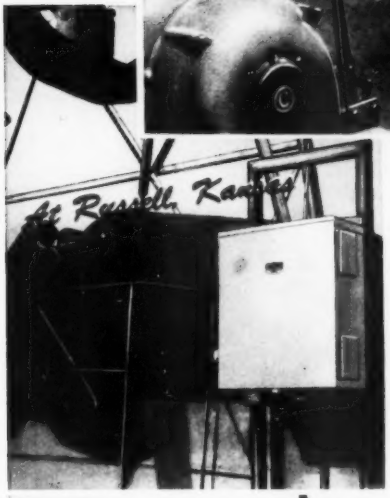
CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

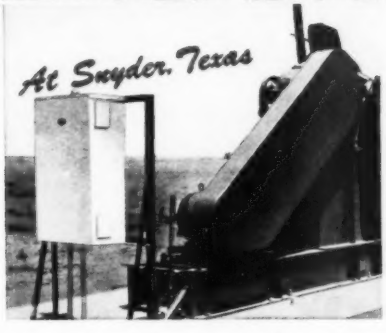
TEXROPE — Belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.

ALLIS-CHALMERS



CUTLER-HAMMER OIL WELL PUMPING CONTROL





Built for the toughest conditions Right for any conditions

It can truthfully be said the Cutler-Hammer Oil Well Pumping Control has been designed and built in response to the practical operating needs of the oil country. It has been built to withstand climatic extremes . . . hot, dusty, insect and storm prevalent conditions . . . or salt-laden, hot, humid atmospheres. It has the "stuff" to stand up anywhere.

The controller case has 4 openings for *adequate* ventilation. The aluminum painted case reflects the sun's heat. You don't have to prop the door open to dirt and insects to keep this starter cool.

The ventilators are fine mesh screened, louvered and plate-guarded to keep out dirt, dust and bugs. The vertical contacts shed dust. The timer case is neoprene-gasketed and dustproof . . . the clock motor has extra power—keeps on running—dependably.

Unit type lightning arresters show their condition at a glance. If one blows, it's clean . . . you don't have to disassemble the starter to clean up afterwards. This control is available without undervoltage relay or *with* undervoltage relay, but the popular type with automatic staggered restarting requires no attention should power fail during a storm, because *proper* restarting is automatic in preset and adjustable intervals. Changes in pumping schedule are easy, accurate. Reset of timer clock is performed by turning a handy palm-sized dial. Wiring diagram with spare parts list and overload heater coil ratings is plastic-covered against grease, sweat, dirt, moisture and wear. These are but a few of the features that make the Cutler-Hammer Oil Well Pumping Control outstanding in the field. CUTLER-HAMMER, Inc., 1453 St. Paul Avenue, Milwaukee 1, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

OTHER CUTLER-HAMMER PRODUCTS FOR THE INDUSTRY

Famous Cutler-Hammer UNITROL Control Center
Groups controls in one centralized, flexible housing. All parts interchangeable. Simplifies installation and wiring. Sections easily added. Simplifies servicing and insures better periodical inspection.

Bulletin 9586 Across the Line Starter
For standard or high torque polyphase squirrel cage motors. Famous features, *vertical* dust-safe contacts, eutectic alloy overload relay. Rugged construction, ample reserve. Dust-tight or water-tight enclosing case.

CUTLER-HAMMER
MOTOR CONTROL
C-H

IT'S PACKED WITH SATISFACTION WHEN IT'S PACKED WITH R/M

You will find Raybestos-Manhattan packings and gaskets in machines like this reciprocating boiler-feed pump, and in practically every other type of fluid-handling equipment in industry. The long line of R/M packings and gaskets is relied on by experienced engineers, not only for pumps, but for valves, compressors, expansion joints, hydraulic rams, and wherever trouble-free service is essential. The R/M distributor near you will gladly help you select the right packing or gasket for your needs. Or write for the R/M Packing Catalog.

R/M

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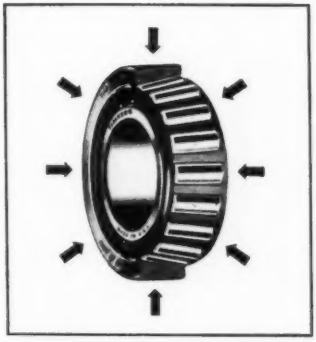
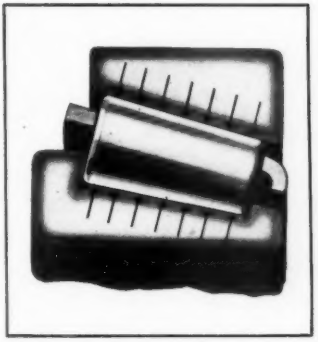


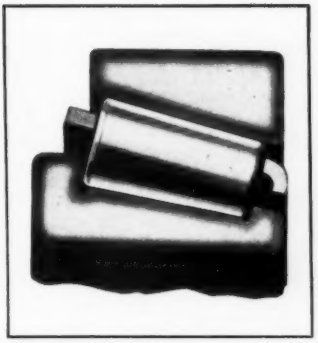
TAPERED CONSTRUCTION

Because Timken® roller bearings are tapered in design, they carry *both* radial and thrust loads. Shafts are held in alignment, auxiliary thrust bearings eliminated, easy adjustment permitted.



LINE CONTACT

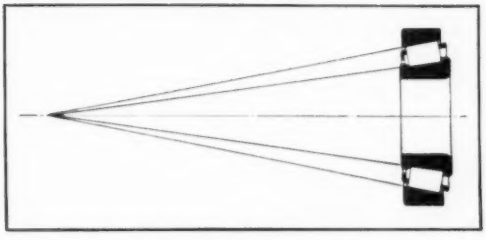
In Timken bearings, the load on the rollers and races is spread evenly over a *line* of contact. Because the load area is greater, Timken bearings offer extra load-carrying capacity.



HARD SURFACE, TOUGH CORE

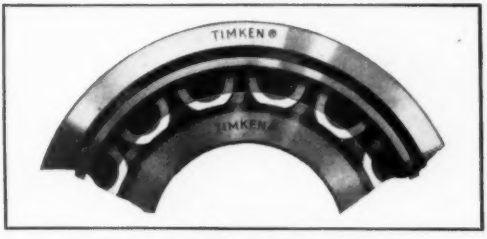
Made of Timken fine alloy steel, rollers and races of Timken tapered roller bearings are case-carburized, resulting in a hard, wear-resistant surface and a tough, shock-resistant core.

To get all this, get TIMKEN® bearings!



TRUE ROLLING MOTION

Since rollers and races of Timken bearings are tapered so that all lines coincident with their tapered surfaces always meet at a common point on the axis of the bearing, the rollers roll smoothly, frictionlessly. Wear is minimized, precision lasts longer. It's another big advantage you get in Timken bearings.



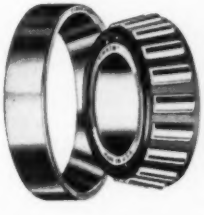
POSITIVE ROLLER ALIGNMENT

Wide area contact between roller ends and rib of the cone insures positive alignment of the rollers in Timken bearings—more precision, less friction, longer wear. Be sure the bearings you buy carry the trademark "Timken". The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



NOT JUST A BALL ◯ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◫ AND THRUST →◫← LOADS OR ANY COMBINATION →✳←

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WITH DETACHABLE,
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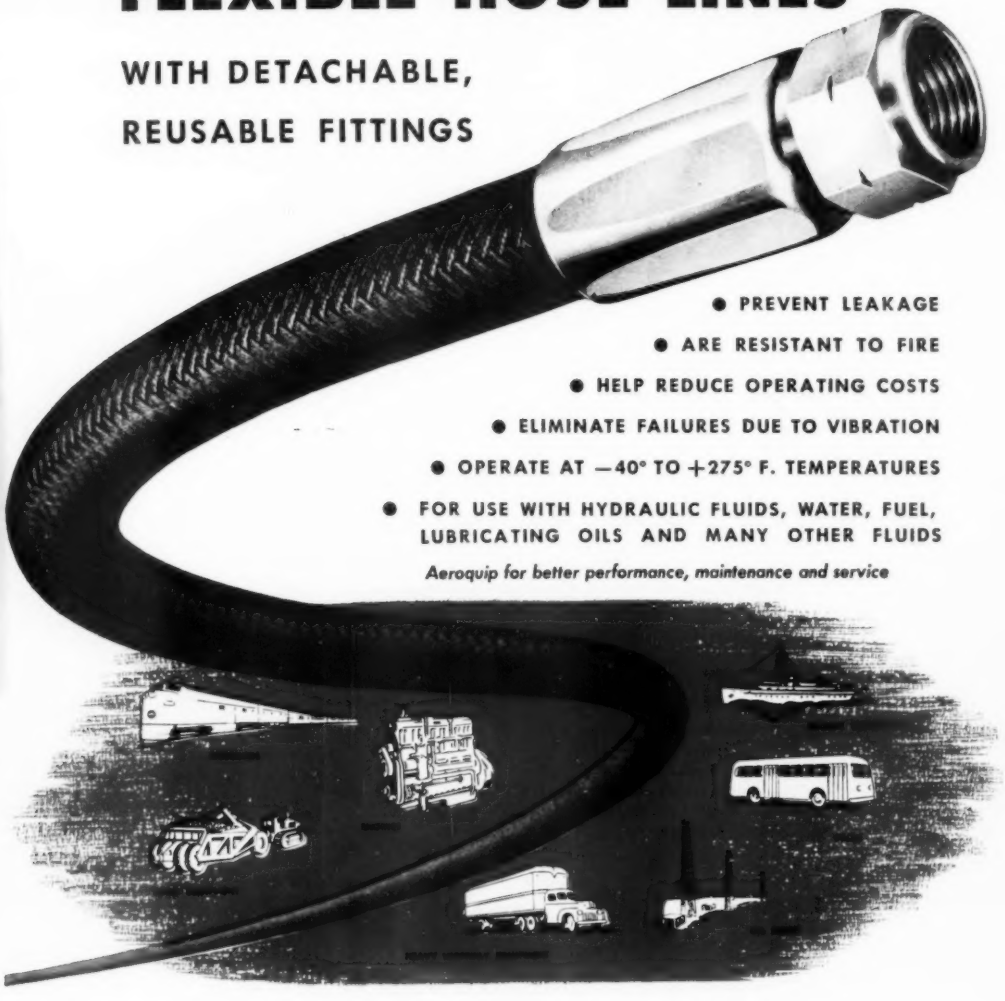

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ADVANCE-DESIGN

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Whatever the job you have for a truck, Chevrolet has the truck that's *right* for your job! It's a new Chevrolet Advance-Design truck, built to cut your trucking costs down to rock bottom. Saves you money when you buy, because the purchase price is low. Saves money right along, because no other truck in its price class offers the great combination of *ruggedness, durability and economy* you get in Chevrolet. Just look at the extra value features that make Chevrolet trucks *stand up better, handle easier, cost little to run and maintain.* Your best truck deal is the deal you get on a Chevrolet Advance-Design truck at your Chevrolet dealer's.

CHEVROLET DIVISION OF GENERAL MOTORS
DETROIT 2, MICHIGAN

CHEVROLET

ADVANCE-DESIGN TRUCK FEATURES

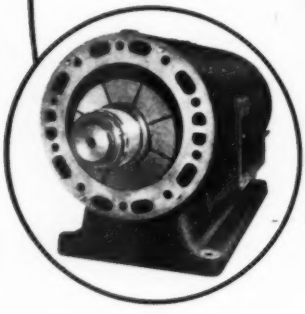
TWO GREAT VALVE-IN-HEAD ENGINES—the 105-h.p. Loadmaster or the 92-h.p. Thriftmaster—to give you greater power per gallon, lower cost per load • POWER-JET CARBURETOR—for smooth, quick acceleration response • DIAPHRAGM SPRING CLUTCH—for easy-action engagement • SYNCHRO-MESH TRANSMISSIONS—for fast, smooth shifting • HYPOID REAR AXLES—for dependability and long life • NEW TORQUE-ACTION BRAKES—for light-duty models • PROVED DEPENDABLE DOUBLE-ARTICULATED BRAKES—for medium-duty models • NEW TWIN-ACTION REAR BRAKES—for heavy-duty models • NEW DUAL-SHOE PARKING BRAKE—for greater holding ability on heavy-duty models • NEW CAB SEATS—for complete riding comfort • NEW VENTIPANES—for improved cab ventilation • WIDE-BASE WHEELS—for increased tire mileage • BALL-TYPE STEERING—for easier handling • UNIT-DESIGNED BODIES—for greater load protection • ADVANCE-DESIGN STYLING—for increased comfort and modern appearance.

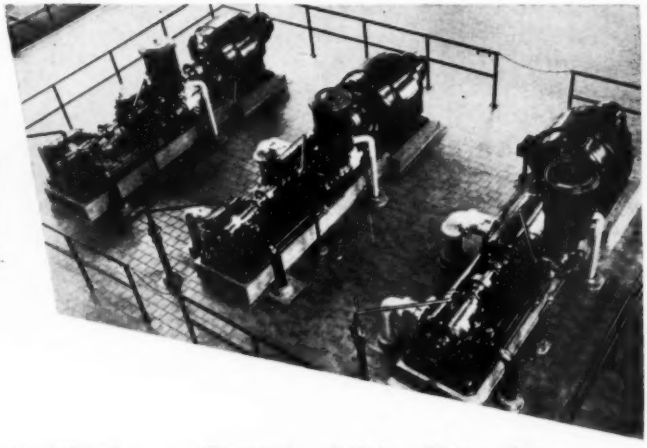
FULLER ROTARY COMPRESSORS

ELIMINATE . . .

Complicated, Moving Parts . . .

for economical operation





Fuller Rotary Compressors are designed and built to be dependable and economical in operation . . . to give a lifetime of new machine service. They have but few moving parts—rotor, bearings, and blades. That means minimum maintenance and infrequent inspection. Because blades automatically compensate for wear, *full capacity is maintained for the life of the machine.* Every detail in Fuller compressors is engineered for one purpose . . . to give you the best machine money can buy.

Thousands of Fuller Rotary Compressors are maintaining peak efficiency in plants of every size and description throughout the country. They've *earned* their reputation for complete dependability.

Fuller engineers will be glad to work with you for the proper application of Fuller compressors to your particular requirements. Bulletin C-5 gives you complete information on these quality built compressors. You'll want to study it carefully . . . see how well Fullers fit into your own plans and operations.

Fuller

DRY MATERIALS CONVEYING SYSTEMS AND COOLERS
COMPRESSORS AND VACUUM PUMPS
FEEDERS AND ASSOCIATED EQUIPMENT

FULLER COMPANY, Catasauqua, Pa.
120 So. LaSalle St., Chicago 3
420 Chancery Bldg., San Francisco 4

C-216

PIPE LINES

...are laid more economically with

J&L STEEL WIRE ROPE

...more permanently with

J&L STEEL LINE PIPE

AMERICA NEEDS SCRAP TO MAKE MORE STEEL

"...here's My warehouse!"

Jones & Laughlin Supply Company

EXPORT: 405 Lexington Avenue, New York, N. Y., U.S.A.
General Offices: TULSA, OKLAHOMA
82 STORES • 17 OFFICES • 6 RESIDENT SALESMEN

J&L STEEL
Subsidiary of Jones & Laughlin Steel Corporation

best
. . . FOR OUTDOORS

● Steam Trapping presents special problems when the condensate cannot be returned to the boiler but is wasted.

Ordinary steam traps then cause much heat loss by discharging condensate at high temperature.

If the equipment is outdoors, there is the further problem of preventing freeze-ups in winter.

On board ship the presence of severe vibration further limits the choice.

ALL THESE DIFFICULTIES CAN BE OVERCOME, BY INSTALLING

SARCO LIQUID EXPANSION STEAM TRAPS NO. 871

This trap discharges condensate to atmosphere at below 212°F regardless of inlet pressure (up to 350 psi). When cold, its large discharge valve is wide open. No special protection against freezing is needed.

AFLOAT use No. 871 on heating coils of tankers and liquid cargo carriers; also to assure dry steam to whistles, winches and other deck machinery.

ASHORE use No. 871 on docks, piers and in railroad yards and terminals; also on outdoor storage tanks and tracer lines or pipe line heaters.

Full details in new bulletin *No. 260.*

NOTE: A special model is available to protect mechanical traps against freezing. It can be set as low as 40°F. Ask for drawing S-1350 on Sarco Thermic Drain.

SARCO COMPANY, INC.

EMPIRE STATE BUILDING, NEW YORK 1, N.Y.
SARCO CANADA LTD., TORONTO 5, ONTARIO
Branches in Principal Cities

350

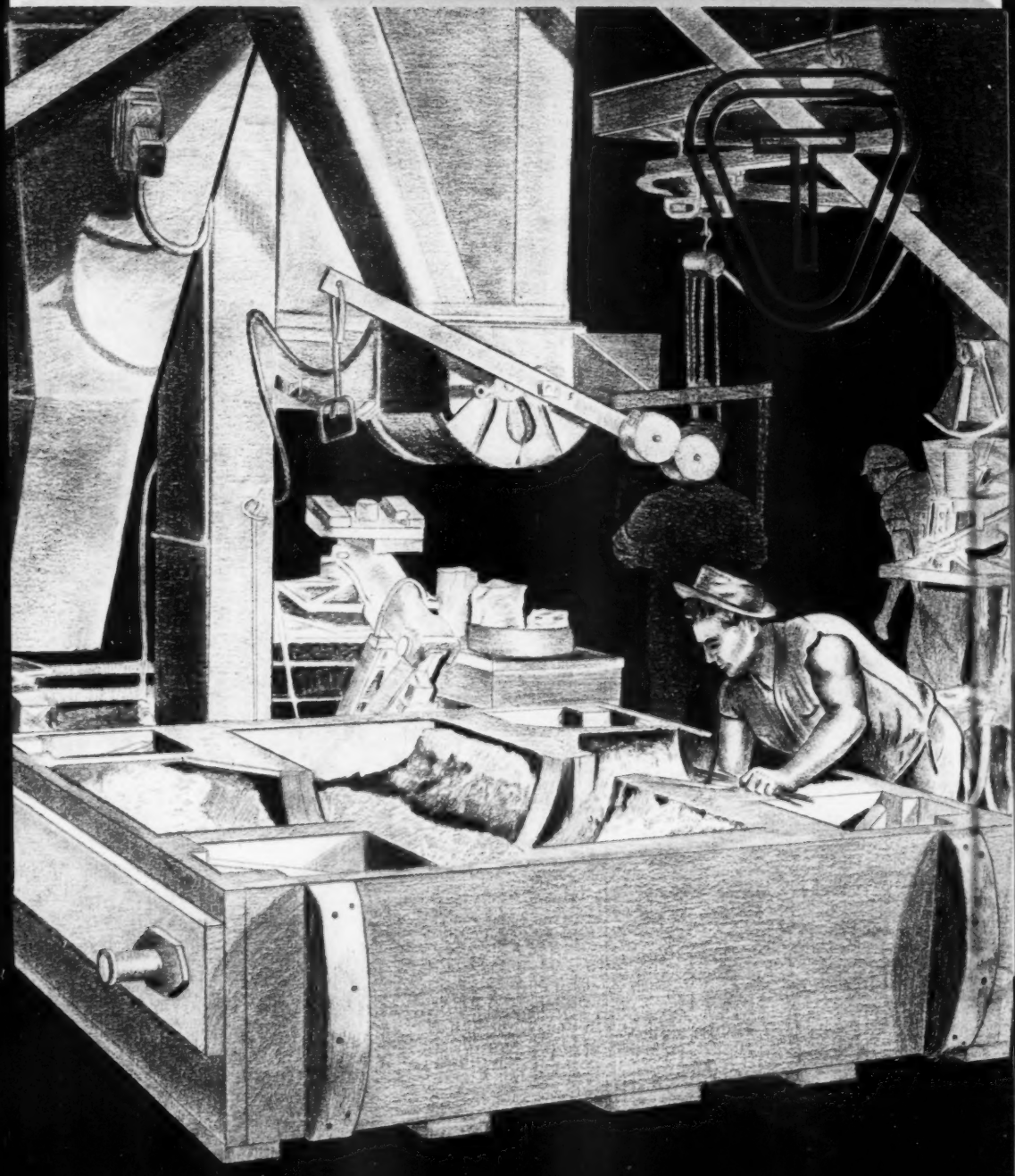
Only Sarco makes Liquid Expansion Traps which use the uniform force of oil expansion to operate a single seated valve of stainless steel.

This valve has a throttling action to provide a continuous flow, but shuts off tightly against steam.

Steam jacketed asphalt lines and a jacketed pump at Globe Roofing Products Co., Whiting, Indiana, are drained by Sarco No. 871 steam traps.

Condensate is discharged to the sewer without excessive heat loss.

Note Sarco Strainers protecting the trap valves against dirt and scale.

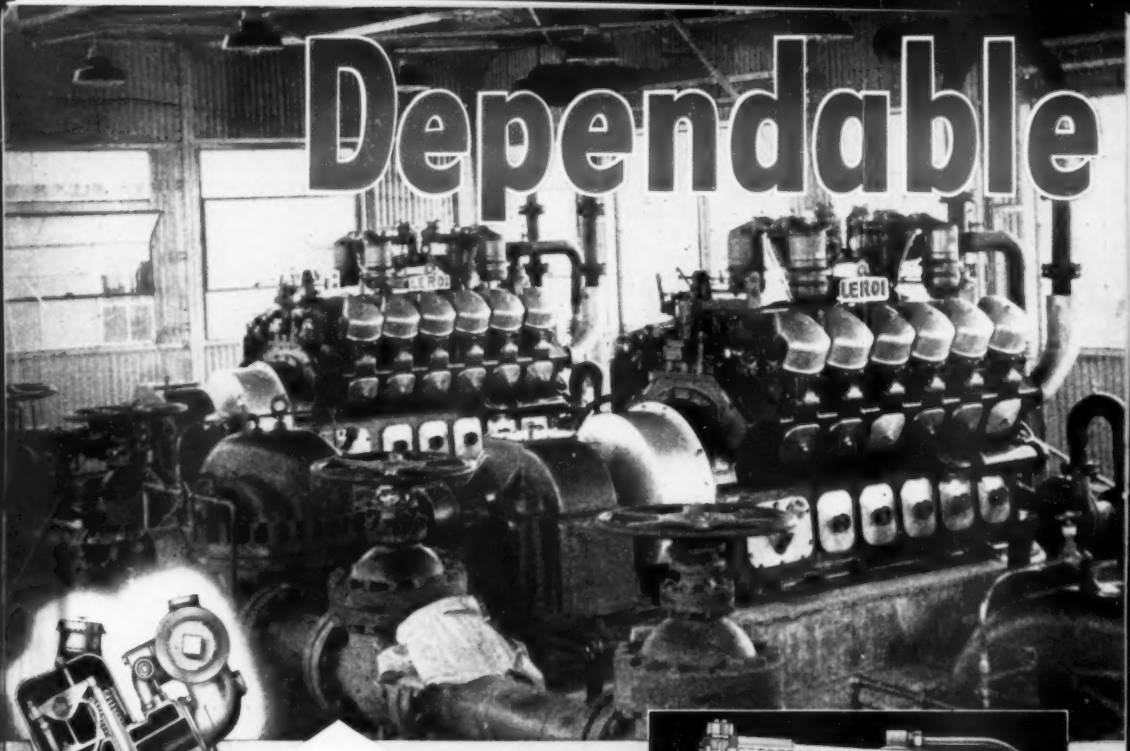


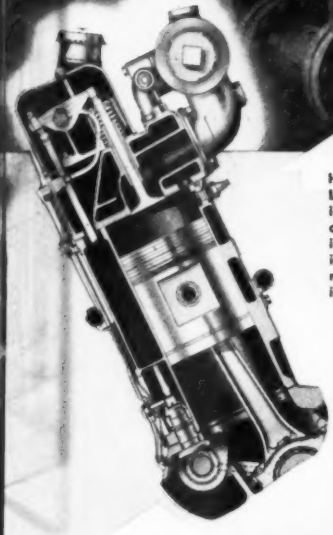
Modern production methods, backed by years of experience, make TESCO your most dependable source of steel castings.

TEXAS ELECTRIC STEEL CASTING CO.

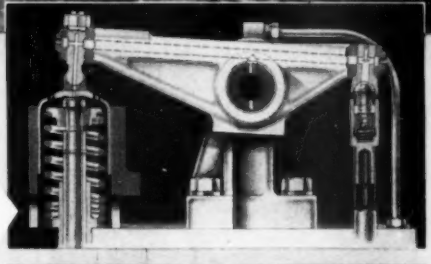
GOOD CASTINGS TESCO HOUSTON, TEXAS

Dependable

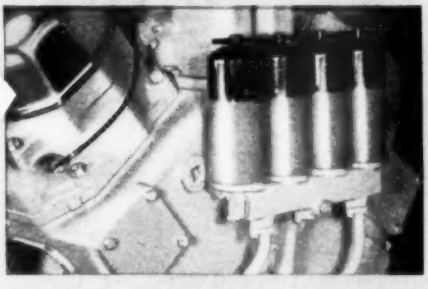




Here's a modern pipeline installation of Le Roi 600 (max) hp L-3460 engines driving multi-stage pumps through speed increasers. Le Roi's 13 years of experience in the pipeline field was a major factor in bringing out the 600 hp L-3460 to meet the industry's need for more power in a low-cost, medium-speed engine.



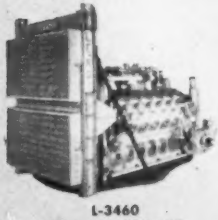
The 600 hp L-3460 is equipped with "zero-lash" hydraulic valve lifters. They eliminate tappet adjustments, increase valve life, make possible smooth, trouble-free operation.



Full-flow, by-pass oil filters and coolers provide sure engine protection — still greater dependability.

Here's a cross section of an RX series engine. Note the guided valve stem mechanism and controlled water circulation around the valves that give long valve and valve-seat life. Light aluminum pistons with full-floating pins are cam-ground and tapered for precise fit, make possible faster acceleration, smoother running.

There's a Le Roi Engine for Every Oil Field Need



L-3460
HP range 280-600

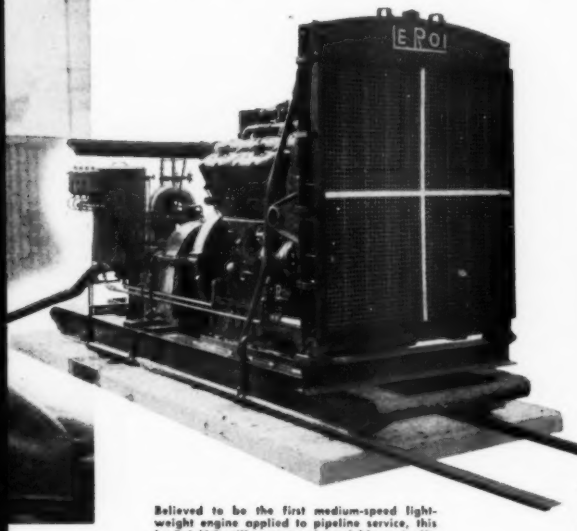
RX Series
HP range 79-410

D Series and H-540
HP range 6-155

A Typical Le Roi Service Facility

Here's the efficient, well-arranged parts department of Le Roi-Rix Co.'s Long Beach branch. Two more offices — at Bakersfield and Los Angeles — are similarly equipped. All three offices maintain prompt 24-hour service. Le Roi has service facilities like these throughout the oil fields — another reason why you can depend on Le Roi.

low-cost power—



Believed to be the first medium-speed lightweight engine applied to pipeline service, this Le Roi V-8 still operates dependably and efficiently in a major pipeline station at Placido, Texas.

Le Roi Engines

. . . for pipeline pumping service

Medium-speed, lightweight Le Roi engines save money on initial investment, and maintenance

An interesting trend was started in 1938, when the Engineering Department of a major oil company decided to use medium-speed, lightweight Le Roi engines in place of conventional, slow-speed, heavyweight units on a main pipeline installation.

The choice of Le Roi was fully justified. The horsepower per dollar cost was lower. The engines were easier to service — service parts more easily obtained. And performance proved to be dependable and economical. Repeat orders followed until the pipeline project was 100% powered by Le Roi. All ten units are still giving good service.

As news of this successful installation spread Le Roi's popularity for pipeline service grew — and an ever-increasing number of Le Roi installations are being made in other fields. Yes, they're swinging to Le Roi — because Le Roi dependability and low-cost maintenance keep operating expenses to a minimum. Moreover, Le Roi engines are backed by complete service facilities in every active area.

No matter what your engine application is, it pays you to call on your nearby Le Roi distributor. He can show you Le Roi engines at work under conditions similar to yours. See why Le Roi *leads the field — in the field.*

LE ROI COMPANY

MILWAUKEE 14, WISCONSIN

Plants: Milwaukee • Cleveland • Greenwich, Ohio — Oilfield Headquarters: Tulsa, Oklahoma

P-108

LEADS THE FIELD

Le Roi Oilfield Sales

Oklahoma
Le Roi Company Branch — Tulsa
Carson Machine & Supply Co.— Oklahoma City

East & South Texas, Gulf Coast
Southern Engine and Pump Company — Houston, Kilgore, Edinburg, Dallas, San Antonio, Corpus Christi, Texas, and Lafayette, Houma, Louisiana.

North & West Texas, New Mexico
General Machine & Supply Co. — Odessa, Snyder, Texas.
Nortex Engine & Equipment Co.—Wichita Falls, Texas.

Kansas
Carson Machine and Supply Co.—Great Bend

Illinois — Western Kentucky
Western Machinery & Engine Company—Centralia, Illinois and St. Louis, Missouri.

IN THE FIELD . . .

Service Network

Michigan
Hafer Engine Service — Reed City

Rocky Mountain Area
Gehring Equipment Co. — Casper, Wyoming, Rangeley, Col.

Northern Louisiana & Mississippi
Ingersoll Corporation — Shreveport, Louisiana, and Jackson, Mississippi.

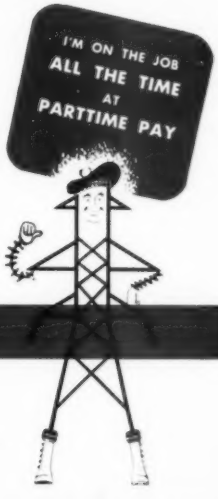
West Coast
Le Roi-Rix Machinery Co. — Los Angeles, Long Beach and Bakersfield, Calif.

Appalachian Area
P. C. McKenzie Co., Pittsburgh, Bradford.

Canada
Lucey Export Ltd. — Calgary, Edmonton, Alberta.

at Pumping Stations
the switch is to . . .

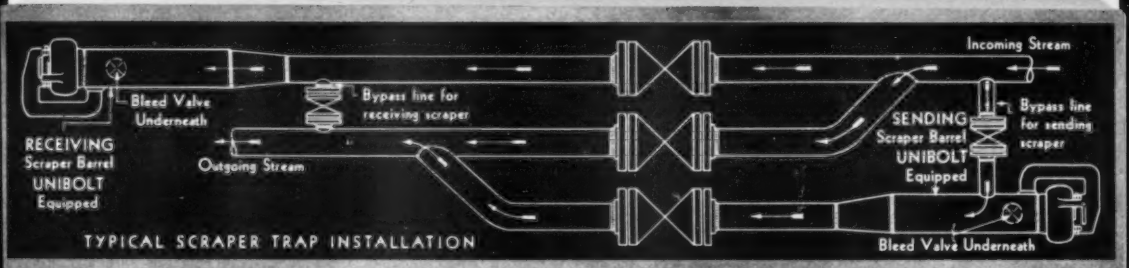
The electrically-operated pipe line station in the above photograph has three 1250-hp motors, two 500-hp motors and six booster pumps ranging from 50 to 100-hp. Located near Cushing, Okla., it is operated by one of the major pipe line corporations. This station handles 150,000 barrels daily through a 22-inch line and 24,000 barrels through a 10-inch line. This is one of many such stations operated EFFICIENTLY and ECONOMICALLY by Purchased Electric Power. Call the Power Engineer of your nearest Electric Power Company for facts on how Electric Power can save you money.



Petroleum Electric Power Association

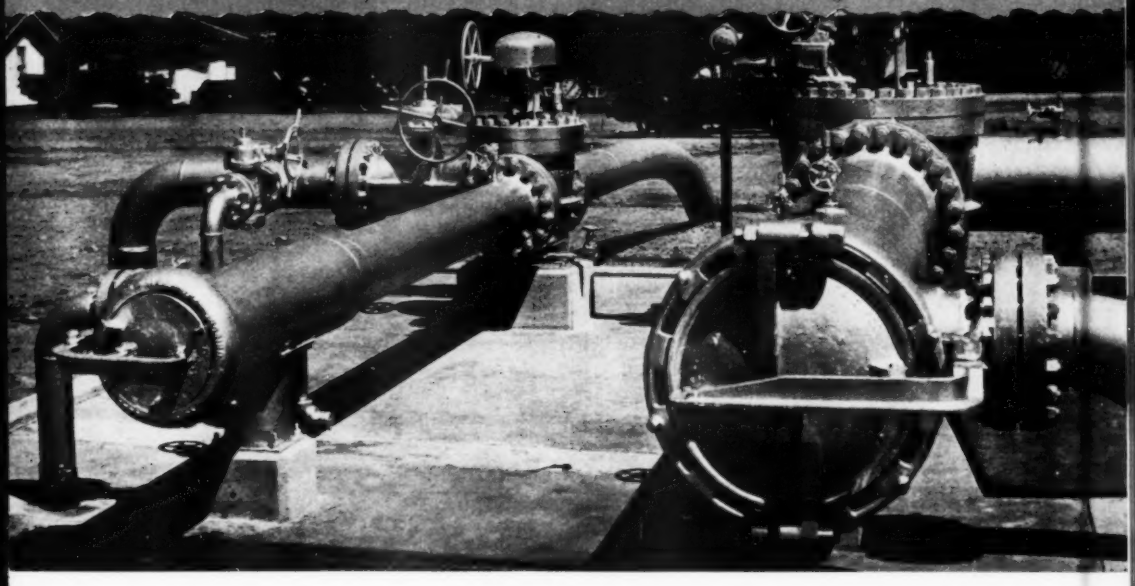
ORGANIZED IN THE INTEREST OF GREATER SERVICE TO THE PETROLEUM INDUSTRY

CALL YOUR NEAREST ELECTRIC SERVICE COMPANY FOR MORE FACTS
OR ADDRESS YOUR REQUEST TO P. O. BOX 2771, DALLAS, TEXAS



TYPICAL SCRAPER TRAP INSTALLATION

THE EASY WAY TO CATCH A PIG!



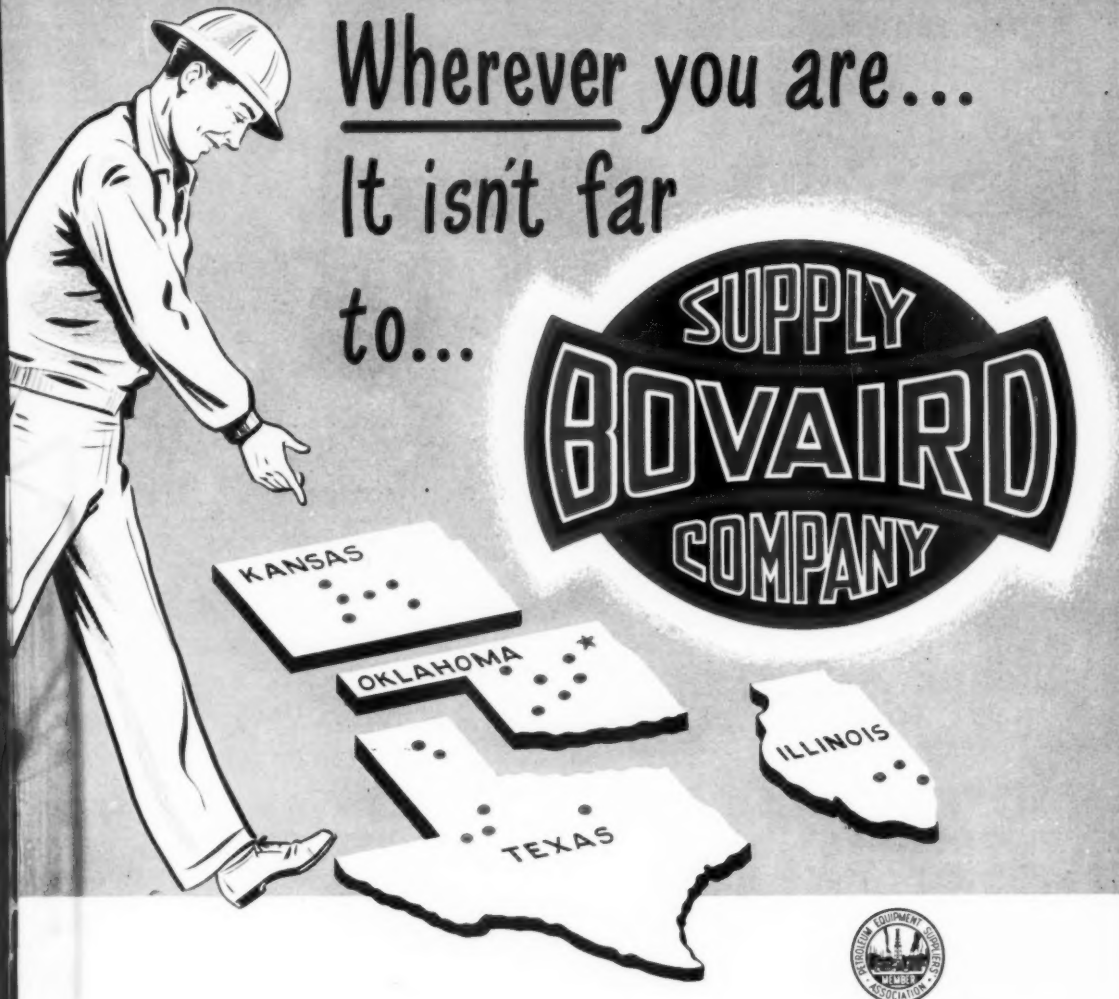
The oversize barrel does the trick. Note in the above sketch of a typical scraper trap installation how an oversize barrel on both the sending and receiving ends of the line provides ample clearance for the pig (which has the same o.d. as the pipe in which it is run). No sidebooms, tractors, rams and strongarm men required. Line pressure does the heavy work.

But that's only half of the story. To further simplify the job, all you need do to open the UNIBOLT Hinged Scraper Trap is release two bolts and the blanking plug swings open like a door. No heavy lifting. Nothing to fall on workmen. No time-consuming blind flanges to make up. No danger of leaks — the UNIBOLT self-sealing oil-resistant seal ring assures a pressure-tight seal.

UNIBOLT SCRAPER TRAP with oversize barrel

Wherever multi-bolt flanged couplings and closures are now being used . . . on strainers, scrubbers, mist removers, terminal manifolds, blowdowns or other pressure vessels . . . UNIBOLT Couplings will serve you better. Send for literature.

THORNHILL-CRAVER COMPANY • HOUSTON, TEXAS



Bovaird stores are strategically located throughout Illinois, Kansas, Oklahoma and Texas to give you complete, dependable, one-stop service for all your supply needs.

You'll find each Bovaird store well stocked with nationally known brands and manned by personnel capable of helping you select the right supplies for your operations.

PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION MEMBER

OFFICES AND STORES

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KANSAS—Chase, Great Bend, McPherson, Pratt, Russell, Wichita

OKLAHOMA—Duncan, Oklahoma City, Pauls Valley, Ringwood, Sapulpa, Seminole, Tulsa

TEXAS—Borger, Dallas, Midland, Odessa, Pampa, Snyder

"Buy From Bovaird"

THE Bovaird SUPPLY COMPANY

GENERAL OFFICES
TULSA, OKLAHOMA

80 YEARS OF PROGRESS WITH THE OIL INDUSTRY

Koppers Bitumastic Enamel being machine-applied

Most effective barrier against corrosion —BITUMASTIC® ENAMEL

KEEP moisture away from pipe-line surfaces with a protective coating and you prevent corrosion. It's as simple as that, in theory. In actuality, though, there's more to the story . . . *ordinary* coatings just can't keep out moisture, year after year.

But Bitumastic Enamels can!

These durable enamels are processed from a base of coal-tar pitch, *making them actually impervious to moisture.* They make a tight bond with the pipe. They do not disintegrate with age. They are chemically resistant to soil elements, and maintain continuously high electrical resistance.

And these qualities pay off. Many of this country's pioneer oil and gas pipe lines—laid in the 1920's—are still giving good service today, thanks to the effective protection provided by Bitumastic Enamels.

Protect your pipe lines, the sure way, by specifying "Bitumastic Enamels." Your Koppers representative will give you complete details and estimates.

Bitumastic Enamels soon available from Koppers new California Plant!

As soon as present construction work is completed, Koppers will be able to supply Bitumastic Enamels from a new plant at Fontana, California. The plant is being built to give you better service in the West.

KOPPERS BITUMASTIC ENAMELS
REG. U.S. PAT. OFF.

KOPPERS COMPANY, INC., Tar Products Division, Dept. 1003-T, Pittsburgh 19, Pa.

DISTRICT OFFICES: BOSTON, CHICAGO, LOS ANGELES, NEW YORK, SAN FRANCISCO AND WOODWARD, ALABAMA

HOW TO BE SURE YOU GET . . .

The extremely high peripheral speeds encountered in speed increasing and high-speed reducing applications present difficult problems in design and construction. These can be answered only by the kind of specialized engineering skill, manufacturing facilities and experience found at the Buffalo plant of Farrel-Birmingham.

SPEED INCREASING UNITS—Farrel Type SI units were the first speed increasers to be developed in a standard series for pipe line pumping service. That was eighteen years ago, and all of the original units, as well as those installed since, are still in operation.

The modern SI line consists of 49 standard sizes with speed ratios ranging from 1:1 to 12:1. For higher ratios, units using two sets of gears are supplied with ratio range from 12:1 to 40:1. Two-pinion units, designed to transmit power from a single engine to two pumps, are also available.

SEMI-HIGH SPEED UNITS—When requirements fall between the range of Type SI units and standard commercial speed reducers, Farrel semi-high speed units are recommended. These units are designed for pinion speeds up to 3600 RPM and gear pitch line velocities up to 4000 FPM.

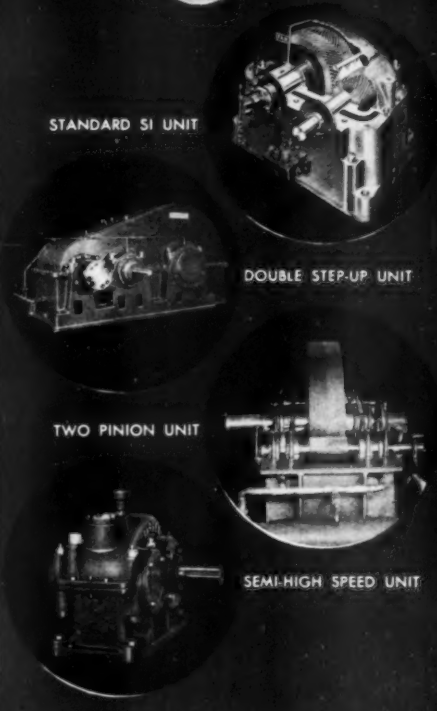
Farrel engineers will be glad to help you select the right gear unit for your high-speed application. Write for further information about any of the types mentioned.

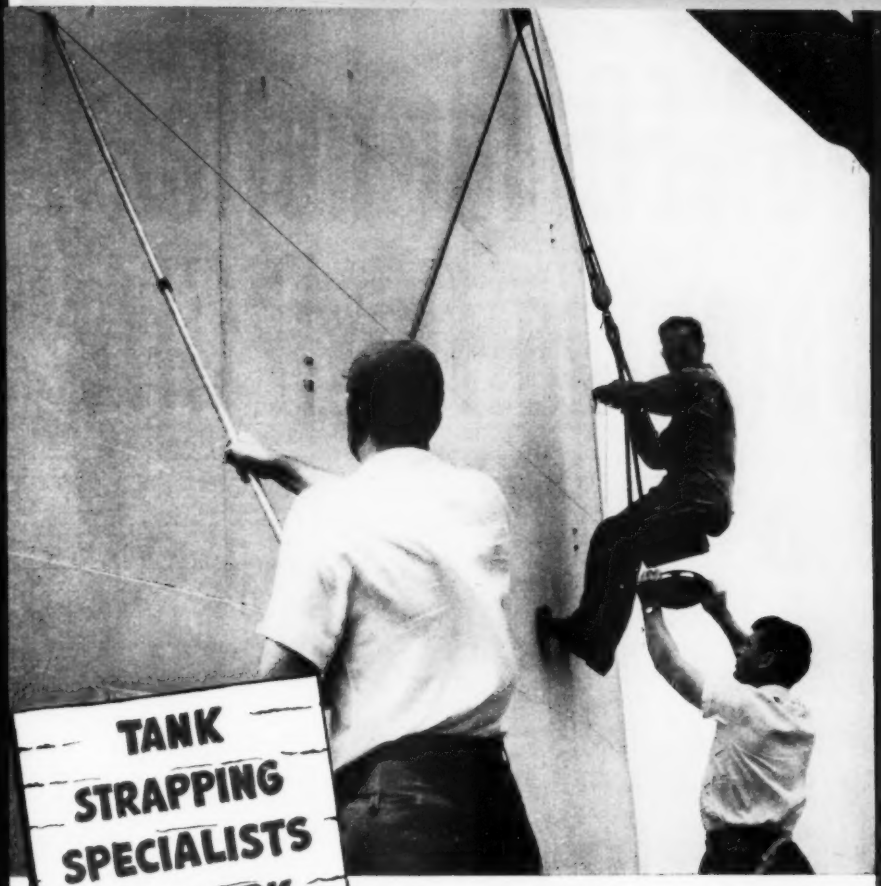
FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.
Plants: Ansonia and Derby, Conn., Buffalo, N. Y. *Sales Offices:* Ansonia, Buffalo, New York, Boston, Pittsburgh, Akron, Cleveland, Cincinnati, Detroit, Chicago, Los Angeles, New Orleans

OIL FIELD REPRESENTATIVES:
Hercules-Lupfer Engine Sales Co., 124 N. Boston St., Tulsa 1, Okla.
V. W. Osborne, 822 A M & M Building, Houston 2, Texas

Farrel-Birmingham®

FB-629





TANK STRAPPING SPECIALISTS AT WORK

Every oil man knows there are 42 gallons in one *barrel* of oil. But—do you know how many barrels are in your storage tanks? . . . *Be sure* by employing CHAS. MARTIN & COMPANY to strap and calibrate your tanks. Our tank tables are *accurate*—computed from measurements made by experienced tank strappers, who follow the latest A.P.I. Codes . . . The cost is *nominal*—equal to the value of only a few barrels of oil per tank . . . Call our nearest office for *prompt* and *dependable* tank strapping and inspection service.

Tank Strappers
B. Brannon, Jack Painton
and Dick Stone

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Port Arthur, Texas
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Houston, Texas
Baytown, Texas
Texas City, Texas
Freeport, Texas
Corpus Christi, Texas
Brownsville, Texas
Helena, Ark.
San Pedro (Port of Los Angeles), Calif.
San Luis Obispo, Calif.
San Francisco, Calif.
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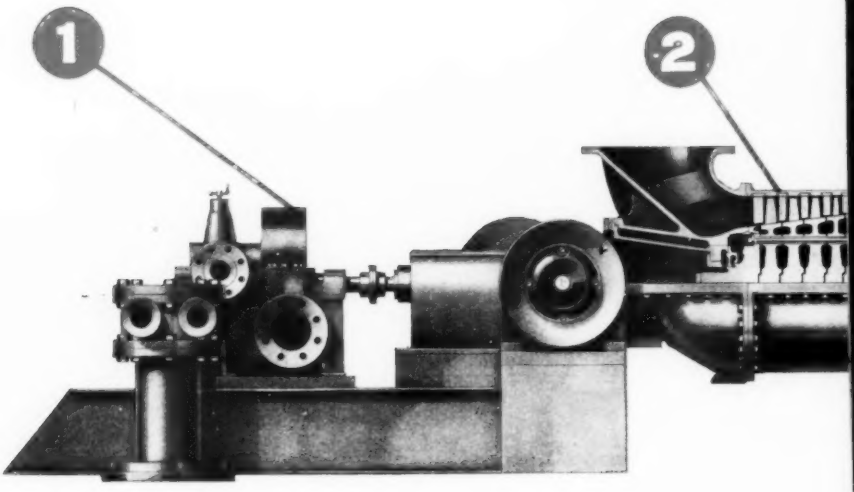
Caripito, Puerto La Cruz
Las Piedras, Venezuela
Ras Tanura, Saudi Arabia

Chas. MARTIN & Company

First

DESIGNED for better gas pumping flexibility



Special G-E features like these provide service reliability, easy maintenance!

1. Important auxiliaries are shaft-driven—The power plant is self contained, and when operating, supplies electric power for camp and all station auxiliaries.

Complete automatic control provides starting, supervision and full protection to power plant. Standard familiar types of instruments and relays are assembled on metal-enclosed switchboard to centralize all control.

2. High efficiency axial flow compressor—The precision-balanced rotor is composed of several wheels bolted to stub shafts, with chrome-iron alloy blades to resist corrosion and erosion, secured by strong dovetails.

3. Periodic maintenance is easy—The all-metallic combustion chambers include stainless steel inner shells to withstand combustion temperatures. These are easily removable for inspection.

4. Strength where strength is needed—The composite turbine wheels have high-temperature stainless steel rims, welded to a forged main shaft and body. The few stages of the impulse type turbine permit use of long-life erosion-resistant buckets of high-temperature materials, with liberal clearances.

GENERAL ELECTRIC

661-3C

New G-E combustion gas turbine—inherently suited for gas pipeline pumping—provides adjustable-speed flexibility for pipeline flow; saves water, oil and manpower!

A "natural" for gas pipeline pumping—that's General Electric's combustion gas turbine! Specifically designed for centrifugal compressor drive, it gives you low-cost operation. In addition:

—You can save on operating manpower and supplies. Power plant control is automatic and self-protecting, with all the important auxiliaries shaft-driven from the main unit.

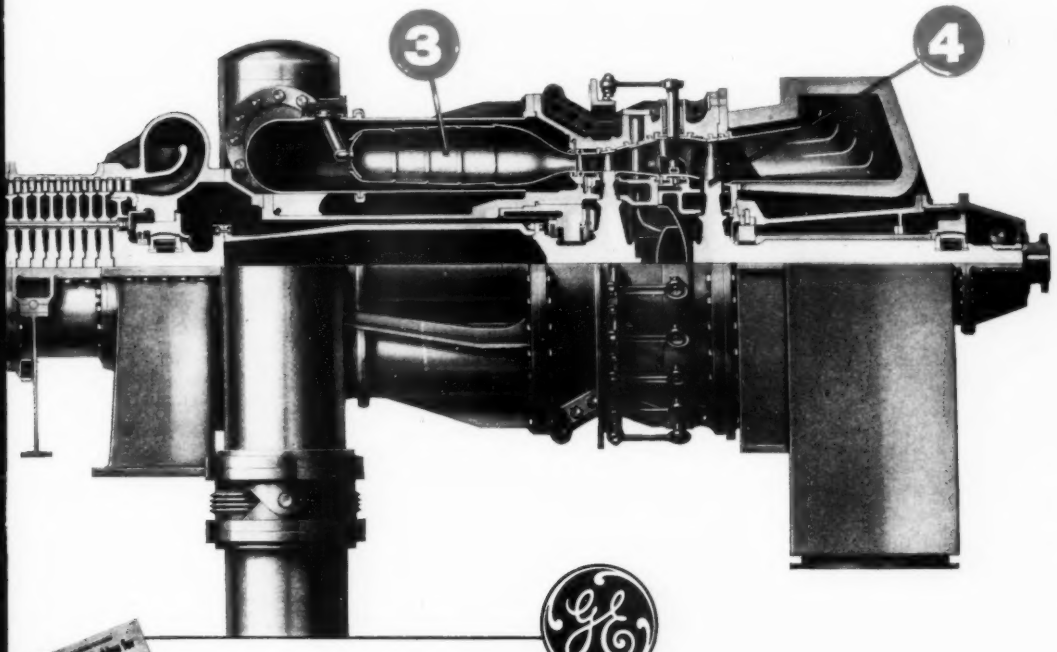
—You save on cooling water—an important point where water is scarce.

—You save on oil. A typical 5000-hp installation requires little or no make-up oil.

—You get adjustable speed for flexibility of operation to suit a variety of pipeline-flow conditions.

—You get up to 25 per cent extra hp in winter, when demand for gas is greatest.

Your G-E representative will gladly discuss this gas turbine in terms of *your* gas pipeline operation.



Send for New Bulletin!

A new 16-page illustrated booklet fully describes the G-E gas pipeline gas turbine. For your copy (Bulletin GEA-5530) call your nearest G-E sales office or write *Section* 661-30, *General Electric Co., Schenectady 5, N.Y.*

—backed by 45 years of turbine leadership!

Most of the World's Newest Pipelines

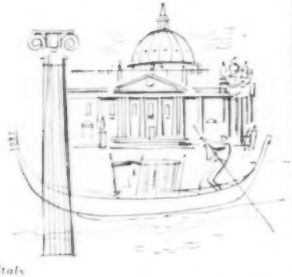
are tied together with

W-K-M PIPELINE VALVES

Arabia

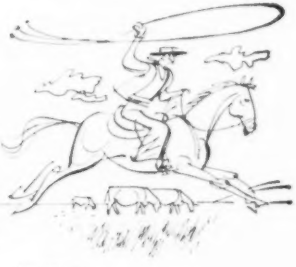
U.S.A.

France



Italy

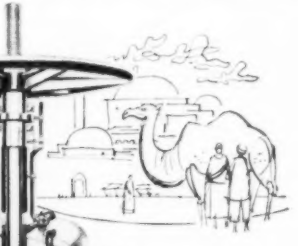
Venezuela



Argentina

Mexico

Bolivia



Kuwait

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OIL FIELD, PIPELINE & INDUSTRIAL EQUIPMENT

HOUSTON, TEXAS, U.S.A.

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Cable Address: "WILKOMAC"

Export Office: 30 Rockefeller Plaza, New York, N.Y.

No roof needed with the ELLIOTT OUTDOOR SPLASHPROOF MOTOR

SAVE THE COST OF HOUSING for motor-driven pump units, by using motors that supply their own housing—protecting against wind-driven rain, mist, dust, sand, snow, or sleet. Motors you can set up outdoors, wherever is most convenient for the work they have to do.

Elliott "Fabri-Steel" construction permits motor design ideally suited to the need, providing the rigidity, crack-proof strength, and rugged endurance which combine with other Elliott refinements to produce a motor outstandingly dependable, no matter what the duty or conditions. It's a natural for pipe line drives.

Available from first size above NEMA frames and larger. Write for bulletin on the motor you need.

155,000 hp now in service or on order

The Elliott Outdoor Motor has gone over big. It's the direct answer to the present high cost of building pump houses and other expensive protection for motor-driven equipment.

ELLIOTT Company

DEPT. OG

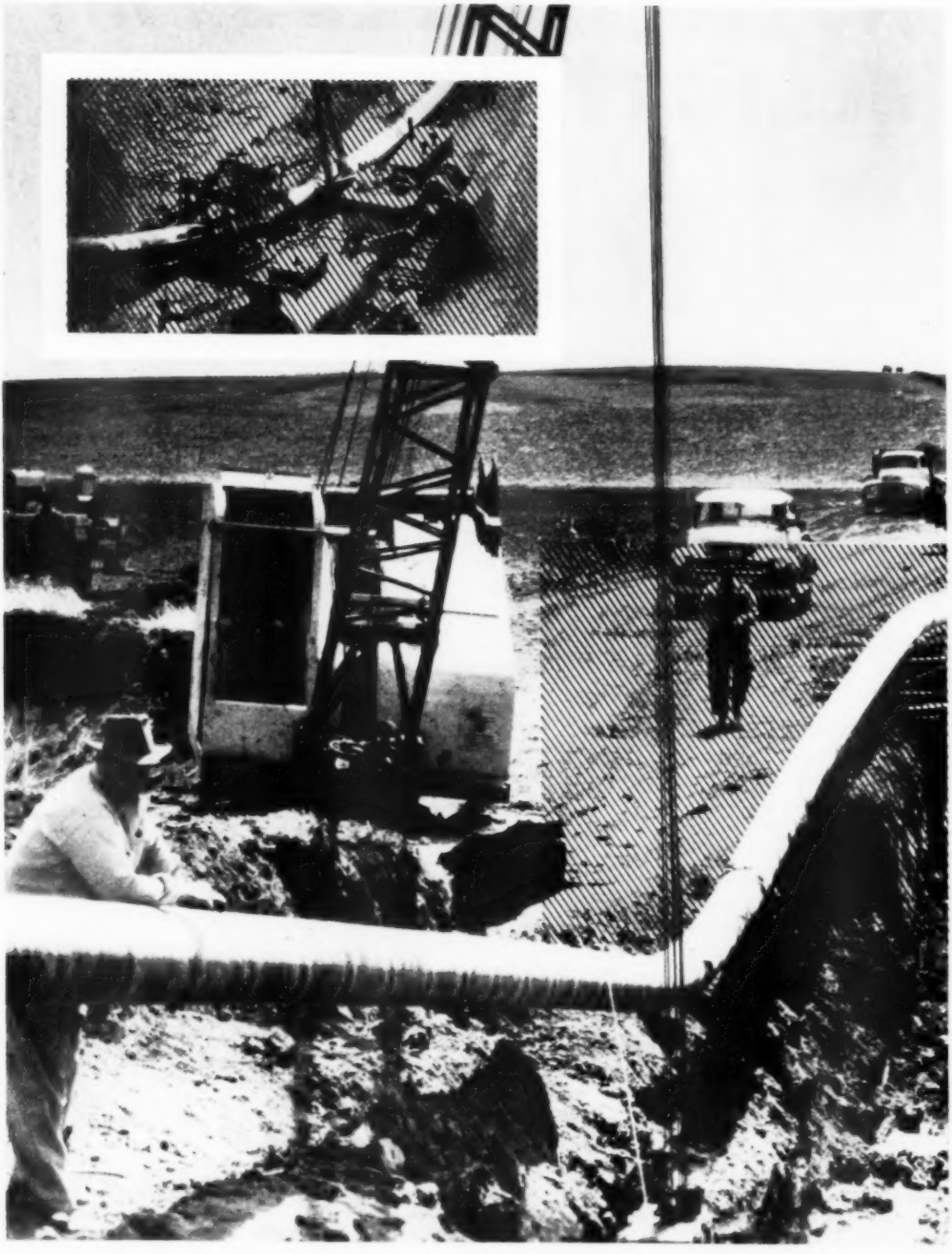
Ridgway Division

RIDGWAY, PA.

L-823

Plants at: JEANNETTE, PA. • RIDGWAY, PA.
AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

In the Nation's great new



underground transportation system

thousands of miles of NATIONAL Seamless Pipe are paying rich dividends in safe, dependable service

● The vast network of pipelines that carries gas, crude oil and refinery products to homes, plants, and factories of America now exceeds 533,000 miles in length . . . 136,000 miles longer than our total railway mileage.

8 out of every 10 barrels of crude oil today move to U. S. refineries by pipeline. Natural gas sales are up 50% since 1945 and all the gas moves through pipelines.

Pipelining is big business. This year alone, 20,000 miles of new pipelines will be laid. In the year just past, the pipeline bill totalled a record-breaking $1 billion plus.

Since the very beginning of this vitally-important transportation system, NATIONAL Seamless Steel pipe has been used in ever-increasing quantities. Thousands upon thousands of miles are now in service. The famous "Big Inch" line was built almost entirely with NATIONAL Seamless . . . the first, and still the finest seamless pipe produced in the United States.

For NATIONAL Seamless is pierced from a solid billet of high-quality steel . . . the one method that removes all doubt concerning uniform wall strength. In these famous "Walls without Welds" there are no lines of potential weakness—no longitudinal welds to weaken or injure the pipe. As a result, pipeline companies have *confidence* in NATIONAL Seamless. They know from experience that money just can't buy anything better.

In the future, as in the past, NATIONAL Seamless quality will be jealously maintained to the same high standards that has made it preferred not alone for pipelines but for drill pipe, casing and tubing as well.

NATIONAL TUBE COMPANY
PITTSBURGH, PA.
COLUMBIA STEEL COMPANY, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

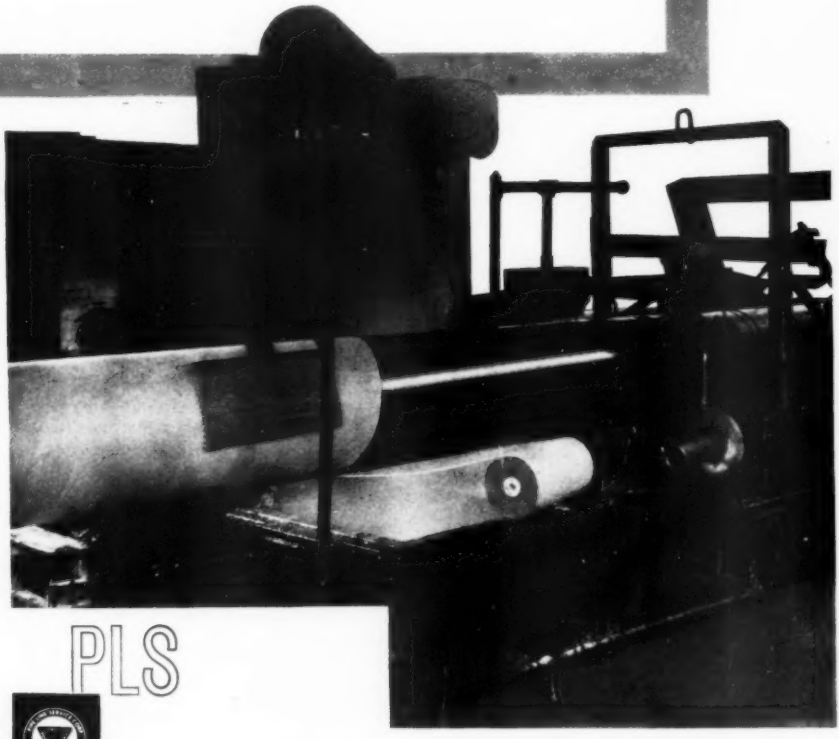
UNITED STATES STEEL

How PRECISION EQUIPMENT Gives You More For Your Money in PLS Controlled Pipe Protection

Nothing is left to chance at Pipe Line Service to give customers uniform, high quality pipe protection. All equipment used has been developed by PLS engineers for maximum efficiency and economy in cleaning, priming, coating and wrapping.

Typical of the precision techniques employed is the coating and wrapping operation illustrated here. The pipe is propelled by positive-drive units which control the forward spiral movement of the pipe through the coating machine. This insures *uniform* lap of wrappers at all times.

Precision equipment like this is operated by trained personnel *inside* our plants to avoid delays caused by weather conditions. These factors add up to PLS *controlled* service which gives you more for your money in pipe protection.

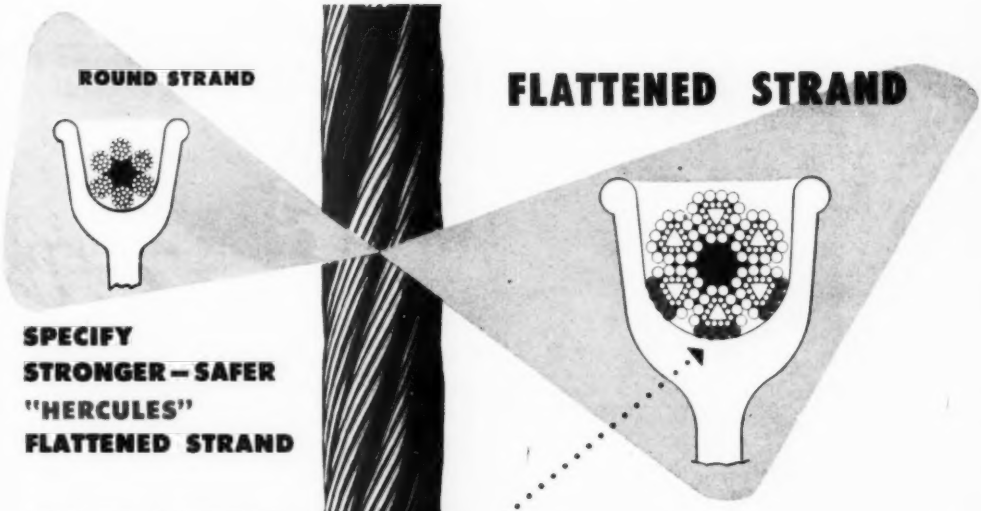


PLS

PIPE LINE SERVICE CORPORATION

General Offices and Plant • Franklin Park, Ill.

PLANTS AT: GLENWILLARD, PENNSYLVANIA; LONGVIEW, TEXAS; CORPUS CHRISTI, TEXAS; HARVEY, LOUISIANA; SPARROWS POINT, MARYLAND



SPECIFY
STRONGER—SAFER
"HERCULES"
FLATTENED STRAND

- 10% EXTRA STRENGTH
- LARGER METALLIC AREA
- SMOOTH RUNNING
- SMOOTH WEARING
- EASIER TO RIG
- EXTRA SAFETY
- EXTRA ECONOMY
- RED-STRAND QUALITY

SPREADS THE LOAD
FOUR WAYS

"Hercules" Flattened Strand design spreads wear over *four* wires—not just one as in round strand. This compact outer surface greatly reduces wear in grooves of drums, sheaves and idlers. Tends to keep them smooth.

The triangular cross-section of the strands permits a smaller core, larger contact area between strands, and greater resistance to crushing. A smaller size Flattened Strand rope can usually be used for the same strength and safety requirements as round strand. Makes for easier rigging in tough spots.

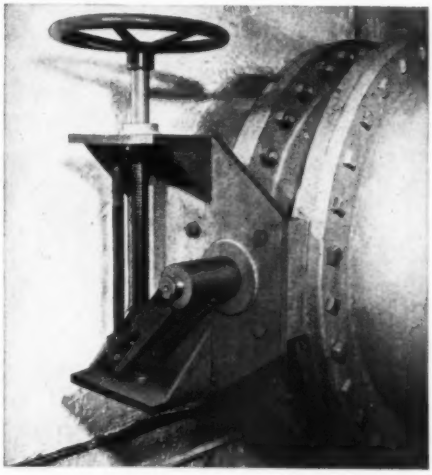
Take advantage of the greater strength and economy of "Hercules" Flattened Strand Wire Rope.

LESCHEN WIRE ROPE

Consult our Engineering Department for specific recommendations. **A. LESCHEN & SONS ROPE CO., 5909 Kennerly Ave., St. Louis 12, Missouri.** Distributors in all principal cities.

R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •



RUGGED Simplicity

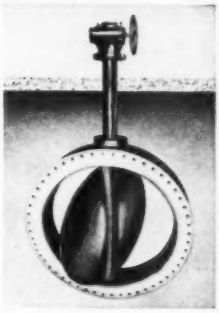
Correctly engineered mechanically and metallurgically, all body assemblies of R-S Valves equal or exceed A. S. A. standards in every detail. These valves are designed and constructed for rugged service and provided with such safety factors that they will exceed service expectations as well as reduce pumping and blower costs.

Consider also the few working parts, greater control rangeability, the self-cleaning feature and the fact that R-S Valves are readily adapted to automatic operation. Know the rugged simplicity of R-S Valves, and get the most from your valve investment.

District offices are listed in telephone directories as, "R-S Products Corp'n Valves".

R-S PRODUCTS CORPORATION
4600 Germantown Avenue, Philadelphia 44, Pa.
An S. Morgan Smith Company Subsidiary

R-S VALVES
Simplify the Control and Shut-off of Volume and Pressure from 2 to 2500 psig
Write for Catalogs 17 and 18



No. 739-740—Sixty-inch, 50-pound Heavy Duty Valve with gear reduction drive and handwheel for handling water at 40 psig. Vertical valve stem enclosed in steel pipe support. Thrust bearing absorbs vertical load.

No. 730—R-S Heavy Duty Floor Stand for rugged service in connection with any standard R-S handwheel operated valve.

No. 767—A 3-Way Valve (Two 24-inch 125-pound Cast Iron Valves bolted to 125-pound American Standard Tee). Electric motor operated by cross linkage. Automatic declutching handwheel for emergency operation.

Check these CLEVELAND "EXTRAS"

—your best insurance for pipeline profits...

Extra low ground bearing pressure (only 6 lbs. per sq. in. in the biggest CLEVELAND) and extra traction through the oversize full-crawler mounting that keep you stepping right along through mud, swamp, sand and sticky clay. Extra power that pays off when "all-good" digging turns into rock, hills and hard frozen ground. Extra heavy-duty construction that cuts costly maintenance down-time, while CLEVELANDS famous "unit-type" assembly allows the few necessary repairs to be made quickly and easily in the field. Extra-low center of gravity that means perfect sure-footed balance on the steepest grades and broken country. Extra maneuverability for easy handling in built-up areas. Extra-long service life that slices your equipment overhead. And extra speed and capacity that set a dependable faster pace for your whole spread. See your local distributor today and put this CLEVELAND "insurance" to work for you. The Cleveland Trencher Co., 20100 St. Clair Avenue, Cleveland 17, Ohio.

CLEVELAND TRENCHERS

keep his feet on the ground

A safer worker – no ladder climbing with risk of falls in wet or icy weather. Faster, more accurate, more consistent, eye-level readings. Less product loss – no opening of hatches for old-fashioned manual gaging. Smith Liquid Level Gages are vapor tight.

Easy to install, even while tank is in service. Slip stream float is lowered through 3" opening. No internal guide wires required. Pays for itself in a short time. Simple, precision construction assures trouble-free service and constant accuracy. Thousands in use on varied products in all parts of the world.

For complete instantaneous control of tank stocks, install the SMITHway Remote Control System of remote reading dials at a master control panel. For complete information, see nearest representative. Write for Bulletin No. 147.

Tank gaging *comes down to earth with quick, easy, eye-level readings. Calibrated in feet, inches and eighths. For pressures to 2 PSI. Operates on tanks of all shapes and heights to 37 feet. Automatic—requires no manipulation of any kind by the operator.*

SMITH 77th ANNIVERSARY 1874 1951

DEPENDABILITY THROUGH RESEARCH AND ENGINEERING

A.O.Smith

METER DIVISION

FACTORIES: 5715 SMITHWAY STREET, LOS ANGELES 22, CALIF. • P.O. BOX 508, SUCCASUNNA, N.J.

Offices: New York, Chicago, Houston, Canada—Toronto, Vancouver.
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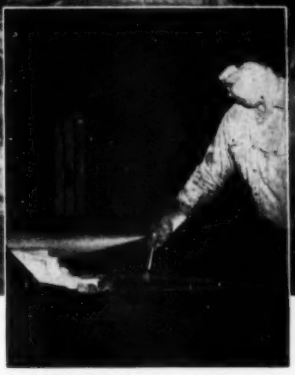

Our closed-die forging equipment includes steam and board drop hammers, 1500 to 8000 lb; mechanical presses to 2000 tons; upsetters 9 in. and smaller.

At *Bethlehem* . . .

A drop-forgings service geared to the customer's needs

Bethlehem is particularly well equipped to produce drop forgings in great variety—countless designs ranging in weight from 1½ to 200 lb.

The Bethlehem service begins with the making of the steel; includes the most modern facilities for die-sinking, forging, treating, cleaning, etc. The product is checked thoroughly at every step and is subject throughout to the proper metallurgical controls.

When in the market for drop forgings, send us your inquiries. You will find us geared to meet your specialized needs.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

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BETHLEHEM STEEL

LIKE A THIEF IN THE NIGHT!

Fiery fingers make away with costly equipment, supplies, and inventories—steal millions of dollars every year in capital assets and production hours lost forever. One match can spark a blaze that will wipe out an entire plant overnight. The Foamite Firefoam Systems, Foamite Airfoam Systems, and Foamite Fire Extinguishers are among the many Alfco products that can halt this thief . . . automatically or manually operated, they are engineered by Alfco experts to afford ideal fire protection to Class A or B risks.

Alfco makes every approved type of fire extinguisher for industrial use. Illustrated here is a Foamite Challenger 40-Gallon Engine. This unit is the best of its type available. Produces more than 450 Gallons of tenacious, free-flowing, fire-smothering Foamite Firefoam . . . famous metering feature permits mixing of chemical solutions in measured quantities throughout discharge period, rather than the dumping of entire contents together at start. Approved by Underwriters' and Factory Mutual Laboratories.

over 2nd Century of Leadership in FIRE PROTECTION

AMERICAN-LAFRANCE-FOAMITE Corporation

ELMIRA-NEW YORK-U.S.A.

ALFCO

Remember the trade marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS, INC.

the engineered way to put an end to a pressure problem

WHEN IT COMES to containing pressures—in a header or pressure vessel or in merely blanking off a line—your safest, surest bet is a TUBE-TURN Welding Cap. Formed to 2:1 semi-ellipsoidal contours, it represents the ideal pressure-resisting closure for a cylinder. No makeshift capping method can approach its bursting strength which is actually far greater than seamless tubing of like thickness and grade of steel.

Another important point: TUBE-TURN Welding Caps are manufactured to meet ASME Boiler Code requirements and the chemical-physical standards of ASTM specification A106 for Grade A and Grade B carbon steels.

For welding caps and for all TUBE-TURN Welding Fittings and Flanges, see your nearby TUBE TURNS' Distributor. You'll find one in every principal city.

Write Dept. J-10 for free booklet giving Dimensional Data on types, sizes and materials of TUBE-TURN Welding Fittings and Flanges.

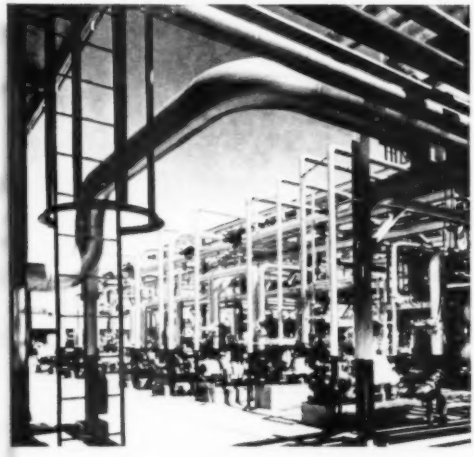
"Be sure you see the double tt*"*

TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Houston • Tulsa • San Francisco • Los Angeles

TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO... A wholly owned subsidiary of TUBE TURNS, INC.

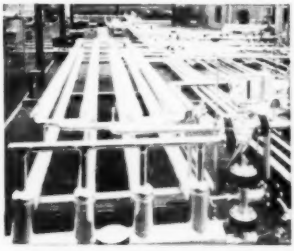
Efficient piping calls for TUBE-TURN Welding Fittings



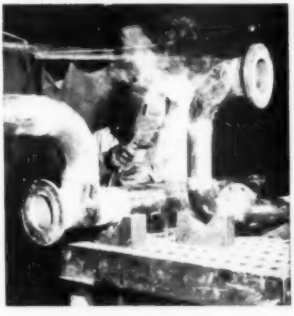
In constructing a refinery's maze of piping, it speeds the job when all the necessary types of welding fittings can be obtained from one reliable source. TUBE TURNS, INC. has the world's most extensive line of welding fittings and flanges, available in a wide range of types, sizes, and more than 40 different alloys.

It's commonplace to handle high gas pressures with safety as at this compressor station. Use of TUBE-TURN Welding Elbows and Welding Neck Flanges makes joints permanent and leakproof, also keeps flow resistance and pressure drops to a minimum. Welders find that ease of alignment with TUBE-TURN Welding Fittings helps them get top quality joints.

To make sure these water knockout and dehydrating lines will not require maintenance, engineers specified use of TUBE-TURN Welding Fittings. True circularity and uniform wall thickness, achieved with TUBE TURNS' unique forging process, insure accurate fit and line-up with pipe, even when fittings are cut to odd angles.



Construction time often is cut when assemblies are welded in the shop, transported, and quickly tied into the system. Such procedure demands accuracy — and welders know they can rely on accurate line-up with TUBE-TURN Welding Fittings.



Want Dimension Data?

Tube Turns, Inc. has compiled a handy folder of charts covering dimensions and weights of TUBE-TURN Welding Fittings and Flanges. If you'd like a free copy just send this coupon.

TUBE TURNS, INC., Dept. J-10
224 East Broadway, Louisville 1, Kentucky

Your Name

Position

Company

Nature of Business

Address

City *State*

DISTRICT OFFICES

New York	Houston
Philadelphia	Tulsa
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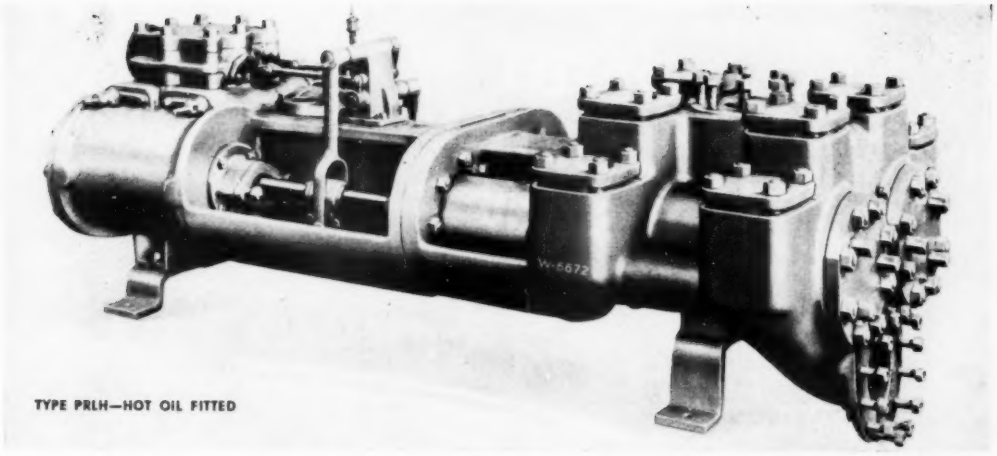
"tt" and "TUBE-TURN" Reg. U.S. Pat. Off.

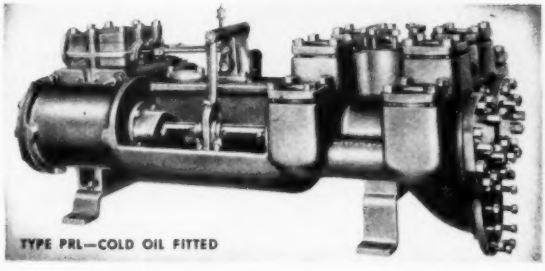
TUBE TURNS, INC.
LOUISVILLE 1, KENTUCKY



TYPE PRLH—HOT OIL FITTED

We've Built New and Superior Strength into

Worthington Steam Pumps



TYPE PRL—COLD OIL FITTED

NEW STEAM ENDS RATED UP TO 250 PSI

Steam cylinders and flanges designed for 250 psi maximum working pressure hydrostatically tested to 375 psi . . . Drop-forged steel steam valve gear . . . Heavier piston rods . . . ½ in. minimum drain openings allow heavier pipe connections . . . Those are some of the *strength features* built into Worthington's new line of steam pumps for refinery service.

MORE FEATURES OF ADVANCED DESIGN

Then, for *longer wear*, the steam valve gear is lubricated—oil cups on the rocker arms give longer bearing life.

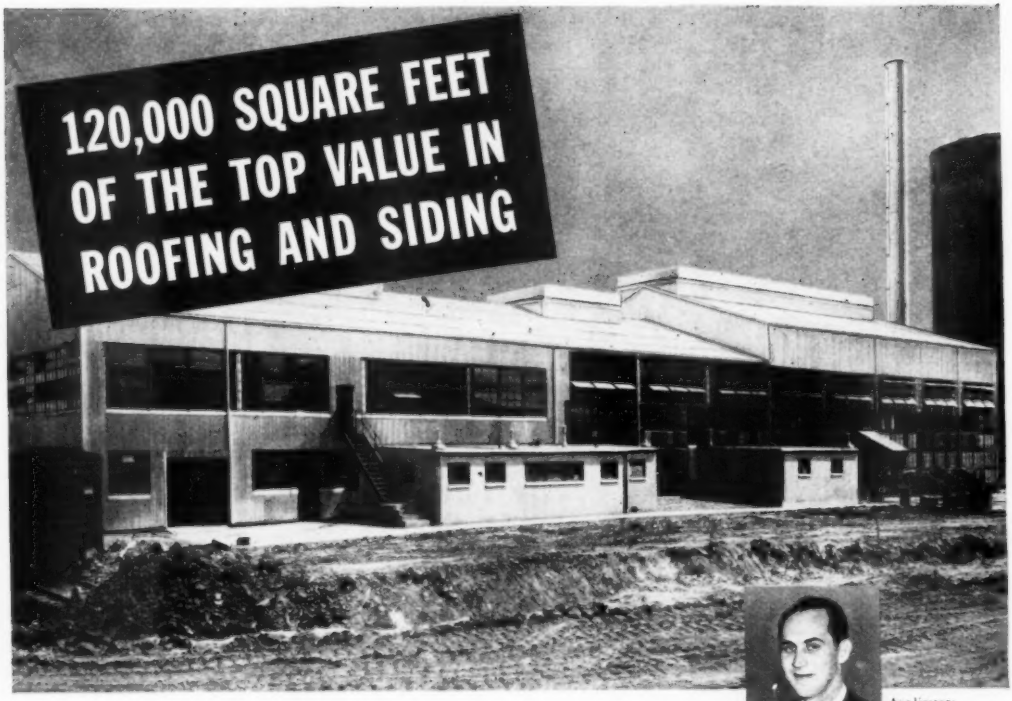
And *accessibility:* two-piece piston rods, either part removable without disturbing the other end . . . flanging on steam cylinder permits easy lagging . . . external cushion valves (on larger sizes).

This new line of duplex steam pumps represents Worthington at its best—the broadest range, the finest engineering. It's one more proof that *there's more worth in Worthington.* For information about specific pumps, write Worthington Pump and Machinery Corporation, Reciprocating Pump Division, Harrison, New Jersey.

WORTHINGTON

P.1.3

THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB

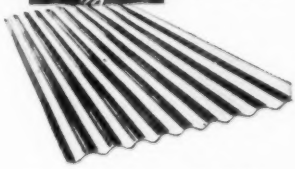


Applicator: M. W. Nabakowski, vice-president of the A. Nabakowski Co.

The Thatcher Glass Company plant at Lawrenceburg, Indiana, called for 120,000 sq. ft. of roofing and siding. The owners and their architects, Herman and Associates, Cincinnati, liked the idea of aluminum. They knew its lighter weight (56 lbs. per square) would save on framing. They knew this rustproof, corrosion-resistant metal would need no painting—practically eliminate maintenance. And aluminum's heat reflectivity would make the buildings cooler in summer, warmer in winter.

M. W. Nabakowski, Amherst, Ohio, roofing and siding applicator, has this to say: "Reynolds Industrial Corrugated is an ideal material because the finished job has eye-appeal, workmen like to handle it, and application costs are easily controlled." But the best testimonial will be written through the years, in superior performance and maintenance economy. It's the top value you want in your next construction. Call on Reynolds for literature, technical assistance and application details.

Offices in principal cities. Check your classified phone book for our listing under "Building Materials," or write: Reynolds Metals Company, Building Products Division, 2005 South Ninth Street, Louisville 1, Ky.



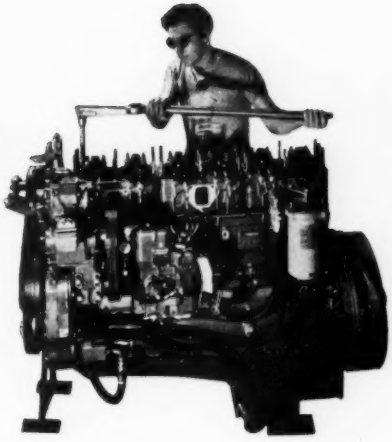
Specifications for Reynolds *Lifetime* Aluminum Industrial Corrugated:

Thickness .032"
Corrugations 7/8" deep, 2-2/3" crown to crown
Uniform load support (roof) 80 p.s.f. on 4' purlin spacing
Uniform wind load capacity (siding) 20 p.s.f. on girt spacings up to 7'9"
Roofing width 35", coverage 32"
Siding width 33-3/4", coverage 32"
Lengths 5', 6', 7', 8', 9', 10', 11', 12'

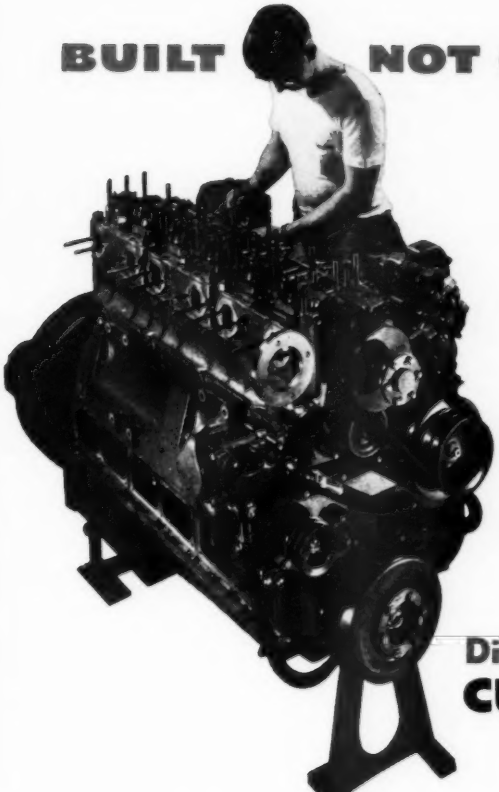
Aluminum is required for planes and other military needs. Reynolds *Lifetime* Aluminum Industrial Corrugated is still produced, but the total supply is necessarily reduced. Rated orders receive priority handling.

REYNOLDS *Lifetime* ALUMINUM INDUSTRIAL CORRUGATED

Cummins®
CUSTOM BUILT Diesels



BUILT NOT ONCE BUT TWICE



Each rugged, lightweight *and* high-speed Cummins Diesel is actually built *twice*. It's assembled, run-in tested, disassembled . . . inspected . . . then reassembled and tested again. And each engine is custom-built *to fit the job*. *Extra* care in building, Cummins exclusive fuel system, efficient service and parts organization, enable users to get *less* "down-time", *more* power and profits from Cummins Diesels. *See your Cummins Dealer.*

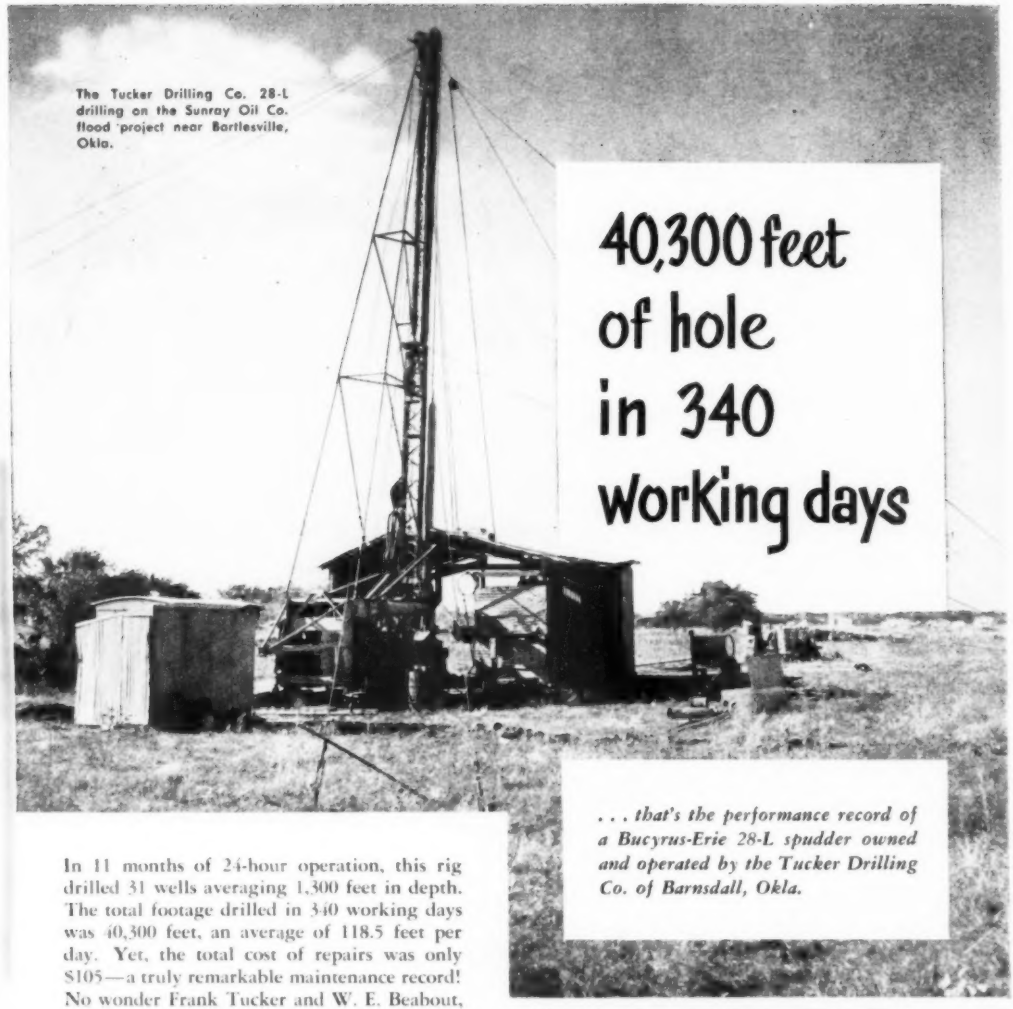
Diesel power by CUMMINS

CUMMINS Dynamatic DIESEL

Lightweight High-speed Diesel Engines (50-550 hp)
for: on-highway trucks
off-highway trucks • buses
tractors • earthmovers
shovels • cranes
industrial locomotives
air compressors
logging yarders and loaders
drilling rigs
centrifugal pumps
generator sets and power units
work boats and pleasure craft

CUMMINS ENGINE COMPANY, INC., COLUMBUS, INDIANA

Export: CUMMINS DIESEL EXPORT CORPORATION • Columbus, Indiana, U.S.A. • Cable: CUMDIEX



The Tucker Drilling Co. 28-L drilling on the Sunray Oil Co. flood project near Bartlesville, Okla.

40,300 feet of hole in 340 working days

. . . that's the performance record of a Bucyrus-Erie 28-L spudder owned and operated by the Tucker Drilling Co. of Barnsdall, Okla.

In 11 months of 24-hour operation, this rig drilled 31 wells averaging 1,300 feet in depth. The total footage drilled in 340 working days was 40,300 feet, an average of 118.5 feet per day. Yet, the total cost of repairs was only $105—a truly remarkable maintenance record! No wonder Frank Tucker and W. E. Beabout, co-owners of the rig, say: "We're very well satisfied with this machine."

This is the kind of output, economy and dependability that has made Bucyrus-Erie spudders favorites among cable-tool men everywhere. Performance like this can make *your* drilling, well completion, or workover jobs pay bigger profit dividends. Your nearest Bucyrus-Erie spudder distributor (see listing on this page) will give you full details on our complete line. 91551

See or Write Your BUCYRUS-ERIE DISTRIBUTOR

BEACON SUPPLY CO. - - - - - - Borger and Pampa, Texas
BECKWITH MACHINERY CO. - Pittsburgh Clearfield and Bradford, Pa.
BUCKEYE SUPPLY COMPANY - - Zanesville and Wooster, Ohio; El Dorado and Chase, Kan.
DRILLERS SUPPLY CO. - - - - - - - - - Joplin, Mo.
DRILLING & MINING EQUIPMENT CO. - - Los Angeles 21, Calif.
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IVERSON SUPPLY CO. - Oklahoma City, Okmulgee and Tulsa, Okla.; Ft. Worth, Kermit, Odessa, Snyder, Houston and Midland, Texas; Artesia and Farmington, N. M.
LUCEY EXPORT LTD. - - - - - Calgary and Edmonton, Alta.
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OLYMPIC SUPPLY CO. - - - - - - - - - Seattle, Wash.
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THE STRAKER SUPPLY - - - - - - - Mt. Pleasant, Mich.
TILLSONBURG PIPE & SUPPLY CO. - - - - - Tillsonburg, Ont.

BUCYRUS ERIE

South Milwaukee, Wisconsin

First with the Finest in Spudders

ON-THE-LEASE TESTING ASSURES ECONOMICAL TREATING OF YOUR OIL

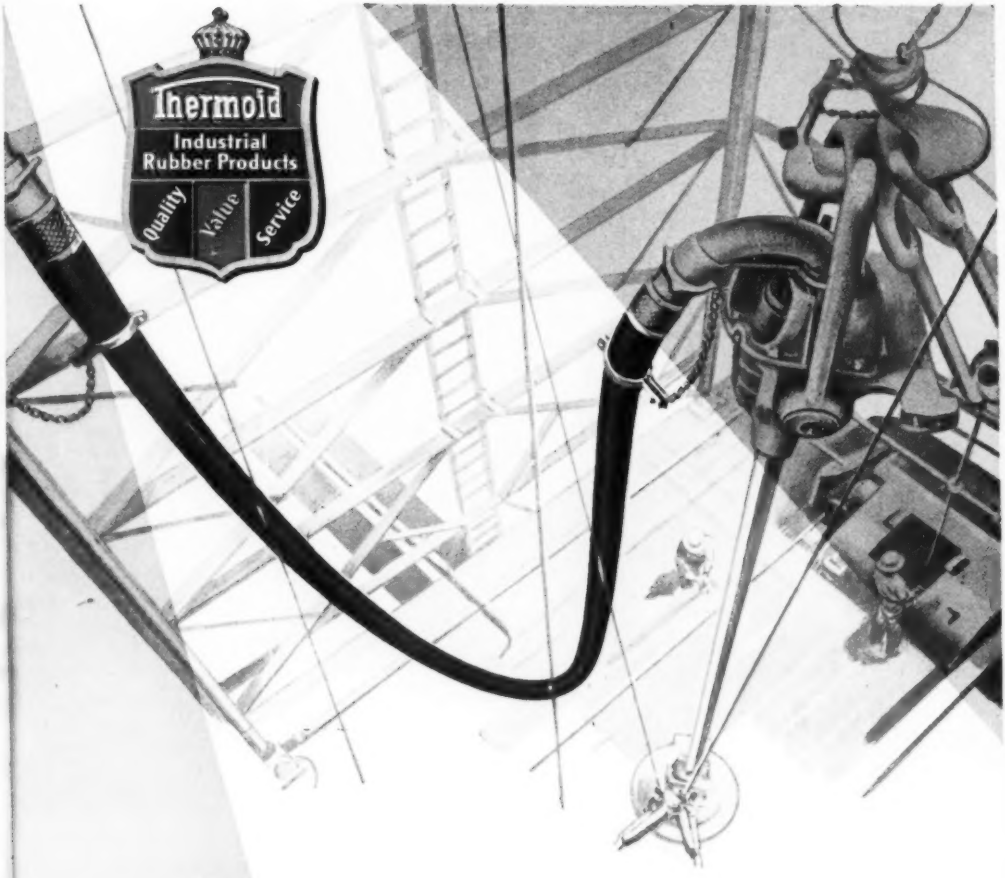
Let one of Humble's Breaxit engineers make live oil tests on your leases to determine the Breaxit formula that will produce pipe line oil for you at the lowest per barrel treating cost.

Whatever your treating problem, there is a Breaxit compound that will give you acceptable pipe line oil at an economical cost.

WITH → BREAXIT

REGISTERED U. S. PAT. OFF.

HUMBLE OIL & REFINING CO.



Powerflex Rotary Hose Is Pre-tested Under Tougher Than Field Conditions

Thermoid Powerflex Rotary Hose is tested to 5000 psi before shipment. And that's a far greater pressure than it will ever meet in the oil fields.

But Thermoid Powerflex can take it. Because, like all Thermoid products, it is made with an extra margin of safety and endurance.

The tube is oil-and-abrasive resistant synthetic rubber, reinforced with steel cables and pre-stretched fabric. Cover resists aging, abrasion, cracking. Couplings are built in, and anchored securely for the life of the hose.

Throughout the oil fields everywhere, Thermoid has come to mean safety, dependability, long-wearing economy—whether it's Powerflex Rotary Hose, "No-Wip" Line Savers, wire line turnbacks or any other Thermoid quality product.

Mid-Continent Office and Warehouse: Houston, Texas

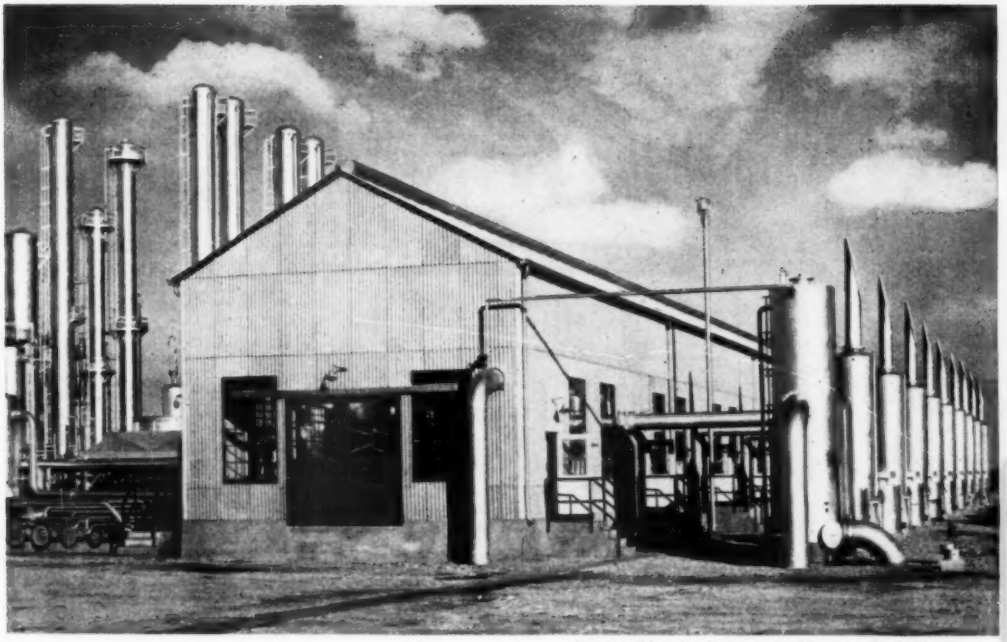
SEE OUR CATALOG IN THE COMPOSITE CATALOG

Powerflex Rotary Hose • Trioflex Slim-Hole Rotary Hose • Mud-Flo Slush Pump Hose • Flexible Discharge Units • F.H.P. and Multiple V-Belts • Oil Country Flat Belting

Thermoid

Wire Line Turn Backs • No-Wip Line Savers • Stuffing Box Rings • All Types of Hose • Molded Specialties • Brake Blocks

Thermoid Company • Offices & Factories: Trenton, N. J., Nephi, Utah



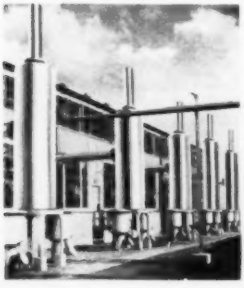
Burgess-Manning Exhaust Snubbers on Clark Gas Engine compressors at a New Mexico compressor station.

Compressor Stations Select Burgess-Manning Snubbers *for Quiet Operation*

● Selection of Burgess-Manning Snubbers by the management of these typical compressor stations is indicative of the wide acceptance by the petroleum industry of Burgess-Manning as the leading authority on effectively reducing noise from engine exhausts and compressor intakes. Almost a quarter century's extensive research and field experience enables Burgess-Manning to handle your engine and compressor noise control problems with the confidence of achieving a successful solution. See Burgess-Manning engineers, today.

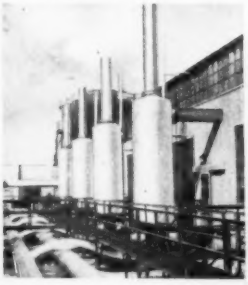
BURGESS-MANNING COMPANY LIBERTYVILLE, ILLINOIS
1203 Dragon Street, Dallas, Texas

Kansas pipe line compressing plant with Burgess-Manning Snubbers installed.

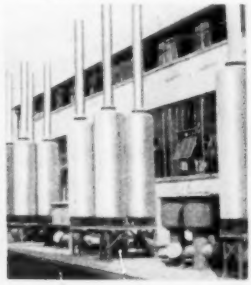


Exhaust Snubbers on engine compressors at a New Mexico gasoline plant.

Texas gas pipe line station with Burgess-Manning Snubbers installed.



Missouri compressor station equipped with numerous Burgess-Manning Snubbers.



WE MAKE *ALL* TYPES OF PLUG VALVES
. . . including the *right* one for *your* needs

HOMESTEAD CAM-SEALD

Straight-way—
Flanged or Screw Ends

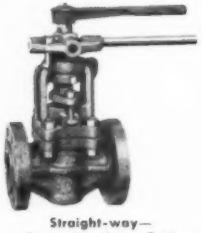
Three-way—Screw or Flanged Ends

Four-way—Flanged or Screw Ends

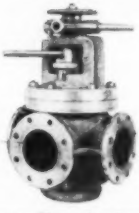
HOMESTEAD CAM-SEALD, QUARTER-TURN PLUG VALVES
(non-lubricated, or pressure-gun lubricated, as desired)

Available in metals for most valve needs; for pressures to 3,000 lbs.; temperatures to 750° F.

HOMESTEAD LEVER-SEALD



Straight-way—
Flanged or Screw Ends



Three-way—Flanged or Screw Ends

Four-way—Flanged or Screw Ends

HOMESTEAD LEVER-SEALD, QUARTER-TURN PLUG VALVES
(non-lubricated, or pressure-gun lubricated, as desired)

Made in combinations of metals and alloys to meet practically any service requirement; from 1½" to 10", from vacuum to 1,500 pounds.

HOMESTEAD-REISER

Straight-way—
Screw or Flanged Ends

Straight-way—
Worm & Gear Operated

Flow-Changer—Non-lubricated

HOMESTEAD-REISER SELF-SEALD LUBRICATED PLUG VALVES
(100% Port Area, or Venturi, as desired)

Available in semi-steel; cast steel; sizes ½" to 12" for steam pressures to 150 lbs.; oil-water-gas to 200 pounds.

We are the only manufacturer who makes *all* of the various types of plug valves used in industry . . . LUBRICATED . . . NON-LUBRICATED . . . FULL PORT . . . VENTURI. We have no "leaders." *We make them all;* therefore, we have no reason to "push" one type valve over another. Our only concern is to see that you get the *right* valve for *your* requirement.

To help you keep this in mind the next time you need plug valves, we'd like to send you our catalog. Why not write for it today.

HOMESTEAD VALVE MANUFACTURING COMPANY
P. O. BOX 403 **CORAOPOLIS, PA.**

Serving since 1892

BARRETT* COAL-TAR ENAMELS PROTECT AMERICA'S GREATEST PIPELINES

HERE ARE 10 REASONS WHY...

1 Products and procedures available for every oil and gas pipeline requirement.
2 Withstand extremely high and low temperatures.
3 High ductility and flexibility.
4 Coatings not damaged by "breathing," nor by back-fill stresses.
5 High dielectric properties.
6 Impermeable to moisture.
7 Resistant to attack by gas and petroleum products.
8 Used by thousands of engineers and contractors.
9 Universally available and easy to apply—applicators all over the country.
10 Barrett engineering service always available.

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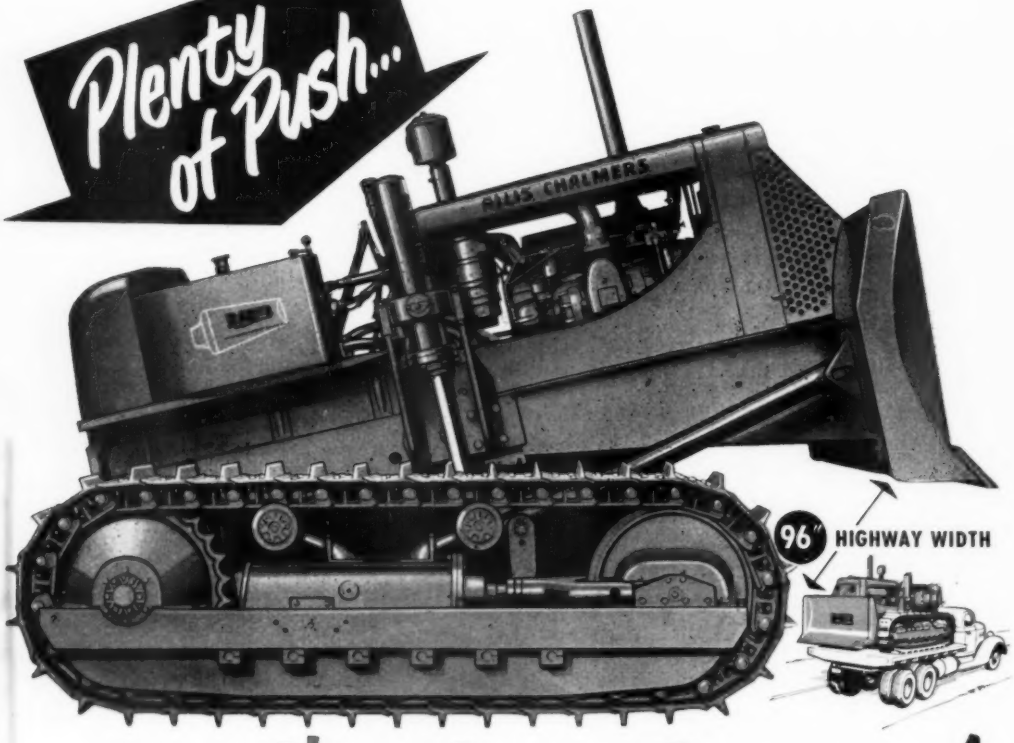
BARRETT Coal-Tar Enamels
Protect The Plantation
Products Line

*Reg. U. S. Pat. Off.

Plenty of Push...



...but NO Push Beams!

Push beams are eliminated *entirely* in the revolutionary new *highway wide* Baker 9-X 'Dozer. Bulldozer and engine frame form an integral unit. Blade responds instantly through double-acting cylinders, which raise and lower tractor-dozer unit. And tying it all together, making it work, is an entirely new design in *stabilizer bars* and *horizontal bearings.*

Here are some of the advantages for many jobs:

HIGHWAY WIDE: Width only eight feet—96 inches—exactly the same as standard highway trailers. Haul the Baker 9-X anywhere, anytime, *day or night,* with NO SPECIAL PERMIT.

PLENTY OF PUSH: Mounted right on an Allis-Chalmers HD-9, the moldboard is 6 inches higher than standard blades to provide almost same blade area, for plenty of push, plenty of capacity—with the famous Baker "move-more-dirt" moldboard curve.

IN FAST, OUT FAST: Steeper angle of approach on the blade because of close coupling. You can get in fast, out fast,

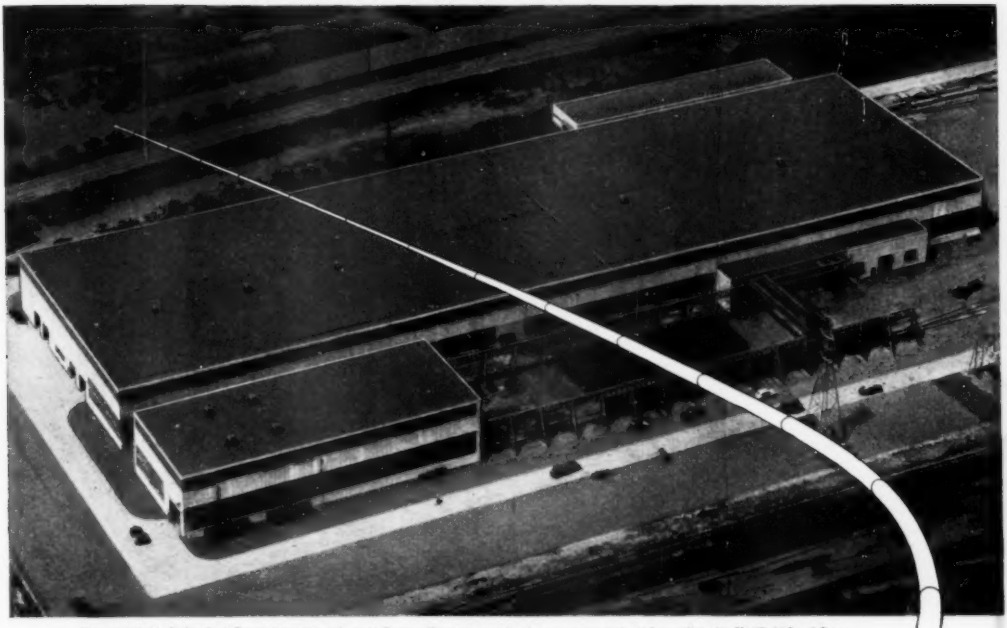
with the Baker 9-X Dozer. Makes it the ideal unit for jobs like slush pits; *makes it the most practical dozer* of all for small-home basements.

FULL LIFT, FULL DROP—Maximum lift is a full 37 inches, maximum drop is full 13 inches.

SURE-FOOTED CENTER OF GRAVITY: Even with blade at maximum lift, center of gravity is 6⅛" behind second roller—not more than a few inches ahead of center of gravity in unmounted tractor. YOU CAN LEAVE BLADE ON FOR DRAW BAR WORK.

LIGHTER: Takes 1,150 lbs. less steel to build . . . costs less to buy. See the new, revolutionary *highway wide* Baker 9-X Bulldozer—another triumph of Baker, Allis-Chalmers engineering cooperation, at your Baker, A-C dealer.

FIRST names in pipelines depend on the FIRST* name in line pipe



Pipe mill of A. O. Smith of Texas, located on Green's Bayou, Houston, next to its co-owner and steel supplier, the Sheffield Steel Corp.

A. O. Smith Welded Line Pipe
Now Flowing from New Houston Facility

- **Increasing A. O. Smith's productive capacity of large diameter welded steel pipe . . .**
- **Reducing freight costs in shipping A. O. Smith line pipe . . .**
- **Assuring a complete range of line pipe sizes, from 8⅝ inches to 36 inches in diameter . . .**

These are the functions of the new plant of A. O. Smith of Texas, with a productive capacity of 200 miles of line pipe per month.

Strategically located, this mill supplements production of the Milwaukee works, placing line pipe convenient to transportation for the great southwest and central states.

Rely on A. O. Smith, known throughout the petroleum industry for its engineering, technical skill and productive capacity.

* FIRSTS by A. O. Smith • Welded line pipe • Internal expanded pipe • Light wall large diameter pipe • World's largest producer of large diameter welded steel pipe.

DEPENDABILITY *through* **RESEARCH** *and* **ENGINEERING**

A. O. SMITH TODAY 77th ANNIVERSARY 1874 · 1951

A.O.Smith

LINE PIPE • CASING

Chicago 4 • Dallas 2 • Denver 2 • Houston 2
Los Angeles 22 • Midland 5, Texas
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San Francisco 4 • Seattle 1 • International
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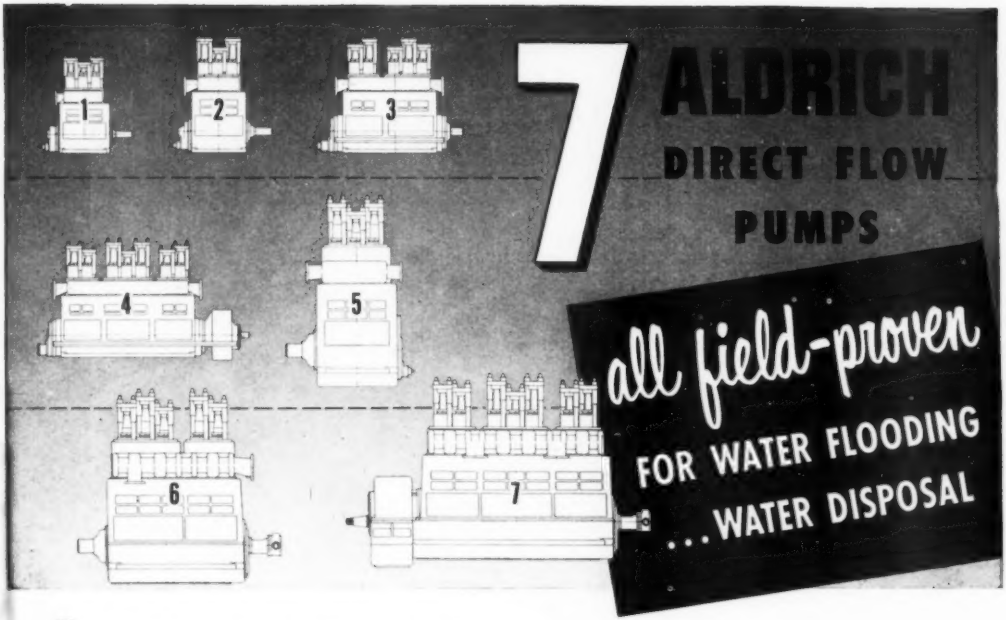


7 ALDRICH DIRECT FLOW PUMPS

all field-proven FOR WATER FLOODING ... WATER DISPOSAL

Every Aldrich Direct Flow Pump shown here is operating on present-day water flood projects. The growing number of Aldrich Pumps at work on water flooding or water disposal is proof of Aldrich's qualifications to take care of your requirements—regardless of volume or pressure needed.

Note these reasons why you can consider Aldrich Direct Flow Pumps specially "designed-for-the-job":

- Reduced space between valves affords higher volumetric efficiency.
- Among 3-, 5- and 7-plunger units of the same stroke size: all wearing parts are interchangeable, and a choice of large or small fluid-ends affords a wide range of plunger selection and makes it possible to change plunger size with minimum investment in new parts.
- Operating speeds have been increased—resulting in greater volume and higher pressure from a lighter, more compact pump.
- Drive by direct connection to synchronous engine type, slow speed motor is available, if desired; and all units feature low engine mounting.
- Aldrich "KOSMOS" Porcelain Plungers and valves made of stainless steel or other special material are available to keep corrosion, wear and maintenance time—*down!*

Contact your nearest Aldrich Representative . . . or write us direct for information. Data Sheets are always available on request.

(1) 2⅛" x 3" Triplex ..... 500 rpm
2,360 bbl per day ..... 1100 psi

(2) 1¾" x 5" Triplex ..... 320 rpm
1,540 bbl per day ..... 2500 psi

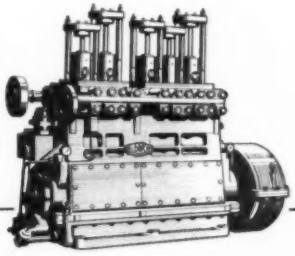
(3) 3¼" x 5" Quintuplex ..... 360 rpm
11,100 bbl per day ..... 713 psi

(4) 2⅞" x 5" Septuplex ..... 375 rpm
11,900 bbl per day ..... 910 psi

(5) 4" x 6" Triplex ..... 277 rpm
8,720 bbl per day ..... 1545 psi

(6) 2⅛" x 6" Quintuplex ..... 250 rpm
3,160 bbl per day ..... 5400 psi

(7) 3½" x 6" Septuplex ..... 250 rpm
15,000 bbl per day ..... 2020 psi



THE ALDRICH PUMP COMPANY

...Originators of the Direct Flow Pump

9 GORDON STREET · ALLENTOWN, PENNSYLVANIA

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RESISTS HOT ACETIC ACID and CHLORIDE VAPORS

AT 158 TO 284 DEG. F.

HASTELLOY alloy expansion joint

This HASTELLOY alloy C expansion joint is constantly exposed to acetic acid vapors saturated with acetyl chloride and containing small amounts of chloracetic acid. Alloy C is practically unaffected by these corrosive vapors at temperatures of 158 to 284 deg. F. Used at the top of a 24-foot distillation still, the joint is also elastic enough to compensate for the almost half-inch growth of the heated tower.

HASTELLOY alloy C and the other two grades of this nickel-base alloy—alloys B and D—are excellent construction materials for all types of processing equipment that must resist corrosive attack. In addition to their unusual corrosion resistance, alloys B and C have high mechanical strength and are available in both cast and wrought forms. Alloy D is available in cast form only. All three alloys are readily fabricated by most common methods. Fill out the handy coupon below for the whole story on these alloys.

"Haynes" and "Hastelloy" are trade-marks of Union Carbide and Carbon Corporation.

HAYNES Trade-Mark *Alloys*

Haynes Stellite Company
A Division of
Union Carbide and Carbon Corporation
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USE THIS HANDY COUPON

Haynes Stellite Company, 725 So. Lindsay Street, Kokomo, Indiana

Please send me the new edition of your booklet, "HASTELLOY High-Strength, Nickel-Base, Corrosion-Resistant Alloys."

NAME_____

COMPANY_____

ADDRESS_____

Over 260
LIMITORQUE*
VALVE CONTROLS
INSTALLED ON

TAPLINE...

WORLD'S LARGEST OIL PIPE LINE

Trans-Arabian Pipe Line is another of the world's great systems on which large numbers of LimiTorque Controls have been installed. Here they are used for remote operation of headgates, block valves, scraper trap valves, station valves, tank farm manifold valves, loading dock valves, etc. The dependability of LimiTorque Controls to function at the mere push of a button, under the most severe climatic conditions has been demonstrated on many wide-spread installations. Valves open and close at the exact speed desired. As the name implies, LimiTorque limits the torque applied to valve operating parts and thereby prevents damage to stems, discs, seats, etc. Each control is equipped with a handwheel for fast manual operation in case of power failure. LimiTorque can always be declutched for handwheel operation regardless of weather or electrical conditions. Any power source such as electricity, air, oil, gas or water can be used for actuation.

Get the full details about LimiTorque in Catalog L-50 . . . Please write on your Business Letterhead.

SM-3 LimiTorque on booster pumps mounted at manifold rack at a station of a well known U.S. pipe line.

Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.
IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

Operating entirely without human attendance is this Union Oil pump station in the Sunset Field near Taft, California.

These Bristol Metameter telemeters transmit readings of temperature, pressure, and flow-rate of the outgoing oil from Sunset Station to McKittrick Pump Station, 30 miles away, where the readings are recorded and indicated on the Metameter Receivers shown below, thus enabling the engineer at McKittrick to keep an eye on Sunset Station.

Metameter* Telemeters Enable Union Oil to Supervise Operation of Unattended Pump Station

The Union Oil pump station at Sunset Field is self-operating. The crude oil is heated to the desired pumping temperature and moved through the pipe line at a prescribed rate of flow. Pumping is slowed down, speeded up, or shut down entirely, if trouble arises or the job is finished. Operations are continuously reported by Bristol Metameter telemeters to McKittrick Pump Station 30 miles away where a Metameter Receiver records the flow-rate of the oil leaving Sunset Pump Station and two Metameter Receivers indicate its pressure and temperature.

Bristol Metameter telemeters are offered in a wide variety of models to take care of almost every type of application involving remote measurement and automatic control (a few feet or many miles) of pressure, vacuum, flow, temperature, liquid level, position, and electrical quantities.

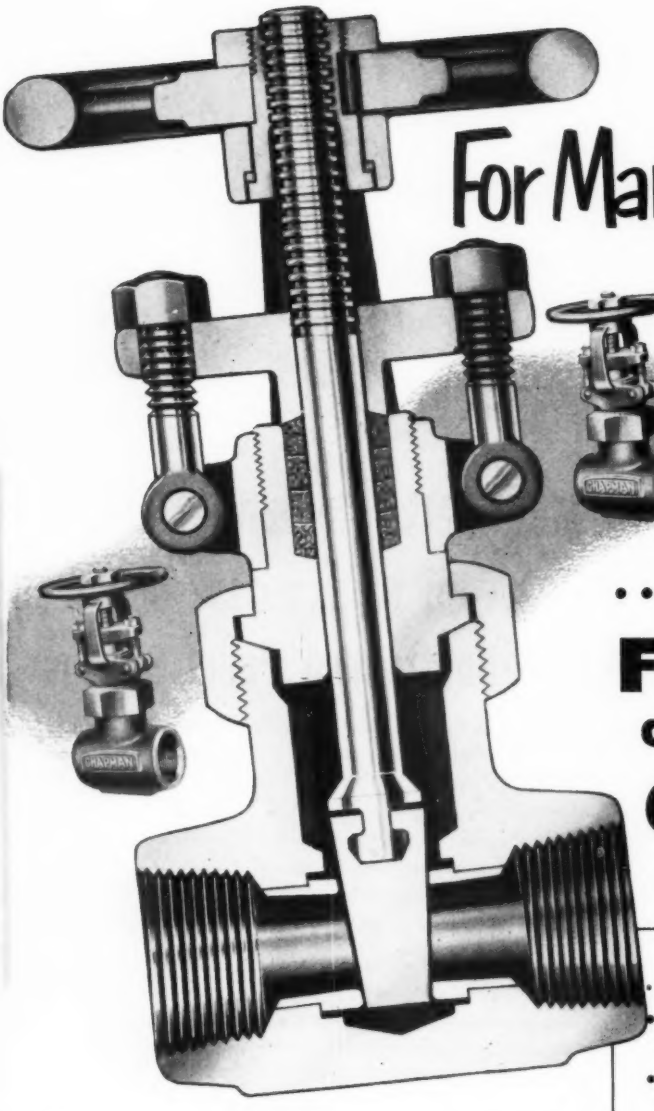
Readings can be transmitted over telephone circuits, carrier channels, private wires, or radio, including microwave. Thousands of installations now in operation from coast to coast. Write for Bulletin M-1700, The Bristol Company, 120 Bristol Road, Waterbury 20, Connecticut.

Reg. U. S. Pat. Off.

THE DEPENDABLE GUIDEPOST OF INDUSTRY

BRISTOL

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS



For Many Services

. . . Use this same

FORGED
GATE VALVE
CHAPMAN
LIST 960

. . . In these different alloys

- Carbon steel forgings with stainless steel (12-14 chrome) trim.
- Stainless steel (12-14 chrome) forgings with stainless steel (12-14 chrome) trim.
- Stainless steel (18-8) forgings and stainless steel (18-8) trim.
- Alloy steel (4-6) chrome body forgings with stainless steel (18-8) or Cyclops trim.

To all the many jobs for which it's qualified, Chapman List 960 brings *extra* wear-resistance in exclusive features like these:

Extra strength of stem-and-wedge gate connection provides protection against even unusual service stress.

Super-hardened seat rings and wedge-faces of stainless steel.

Bolted Follower with no follower threads on yoke to corrode. Follower easily tightened down any time when necessary.

List 960 comes in sizes from $\frac{1}{4}$" to 2". Joints either gasketed or metal-to-metal. Two types: Rising stem with yoke (shown), or rising stem with inside screw. Pressure range: 2000 lb. at 100°F.—380 lb. at 1000°F. (For higher pressures, specify List 990.) Send for illustrated bulletin on List 960.

The CHAPMAN Valve Manufacturing Company
INDIAN ORCHARD, MASSACHUSETTS

P&H DIESEL ENGINES

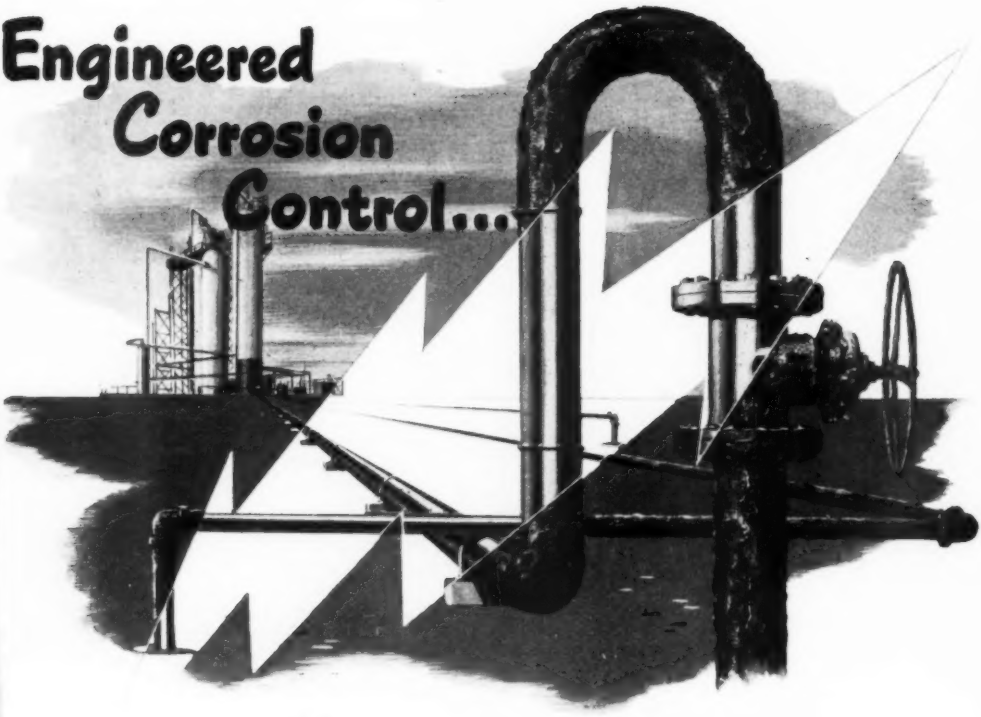
2-CYCLE

Almost any part FITS THEM ALL!

• Think how that cuts your costs . . . simplifies parts stocking . . . speeds up service. 80% of *all* parts fit *all* P&H Diesels—1, 2, 3, 4, and 6-cylinder models. For example, the standard cylinder and liner assembly can be replaced in *any* P&H Diesel in only 40 minutes. You don't even drop the pan. Greater interchangeability is one more reason you should standardize on P&H Diesels. Available in bare engines, power units and generator sets. Write for literature, Diesel Division, Harnischfeger Corporation, Port Washington, Wisconsin.

P&H DIESEL DIVISION
HARNISCHFEGER CORPORATION
PORT WASHINGTON WISCONSIN, U. S. A.

Engineered Corrosion Control...



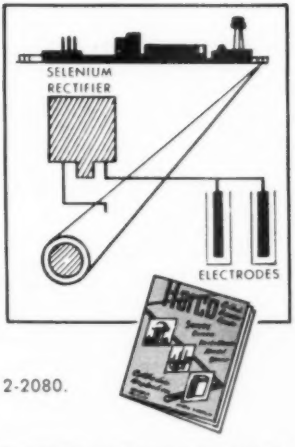
WITH *Harco* CATHODIC PROTECTIVE SYSTEM

ENGINEERED TO YOUR CONDITIONS, HARCO SYSTEMS COMPLETELY ELIMINATE CORROSION in all types of pipeline installations, water storage tanks, metal conduit, etc.

HARCO ENGINEERING SERVICE includes the complete design and installation of cathodic protection systems to assure increased working life and reduce maintenance for installations normally affected by corrosion. In addition, these systems make possible lower depreciation rates and greater protection against personnel injury and property damage resulting from corrosion.

HARCO engineers consider every factor involved to guarantee complete cathodic protection in each individual installation. Among these variables are soil conductivity, moisture content, dissolved oxygen content, temperature, seasonal variations of environment, protective coatings, dissimilar metals, position of other metallic structures and presence of stray currents.

For complete and expert corrosion elimination service, specify HARCO. Write today for catalog or call MOntrose 2-2080.



THE *Harco* CORPORATION *Cathodic Protection Division*

OFFICES IN PRINCIPAL CITIES

16961 BROADWAY • CLEVELAND, OHIO

When The New Oil Era Dawned At Spindletop...

LUNKENHEIMER VALVES

Were Already Established As Oil Industry Favorites

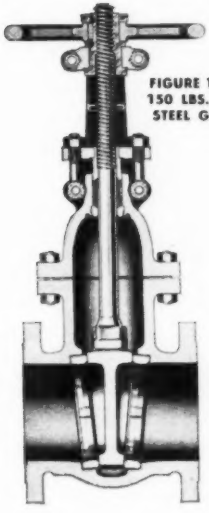


FIGURE 1751
150 LBS. S.P.
STEEL GATE

Spindletop gushed . . . and the rush was on. It was the beginning of a new industry for the Southwest . . . and a new era for oil. The pioneer OIL AND GAS JOURNAL was a lusty infant, heralding the fabulous Texas oil-strike. And Lunkenheimer valves were in *new* demand—to control the new networks of oil transportation and storage that soon reached across America. Since the earliest days of the oil industry, Lunkenheimer valves have been established favorites . . . and today, they are still unmatched for round-the-clock petroleum service. Today's widely-used Lunkenheimer Fig. 1751 is a Steel Gate Valve, rated at 150 lbs., and especially engineered for oil service. It's available with trim for lubricating fluids in sizes from 2 to 24 inches. Modern end-seated rings can't warp as they're tightened . . . seal against the body wall to prevent internal corrosion. The wedge rises clear for streamlined flow that reduces turbulence and keeps pressures high. You can repack the Fig. 1751 while it's fully open and under pressure. And you'll like the extra wear you get from its sturdy stem-threads and carbon steel pressure-parts. *"Lunkenheimer Oil Industry Valves," a catalog-brochure in color, describes more than 50 popular "service engineered" valves for the petroleum processing field. Your copy is available from* The Lunkenheimer Co., Box 360F, Cincinnati 14, Ohio.

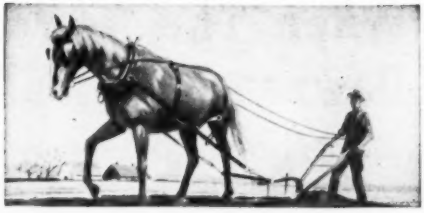
STEEL • IRON • BRONZE

L-351-13A

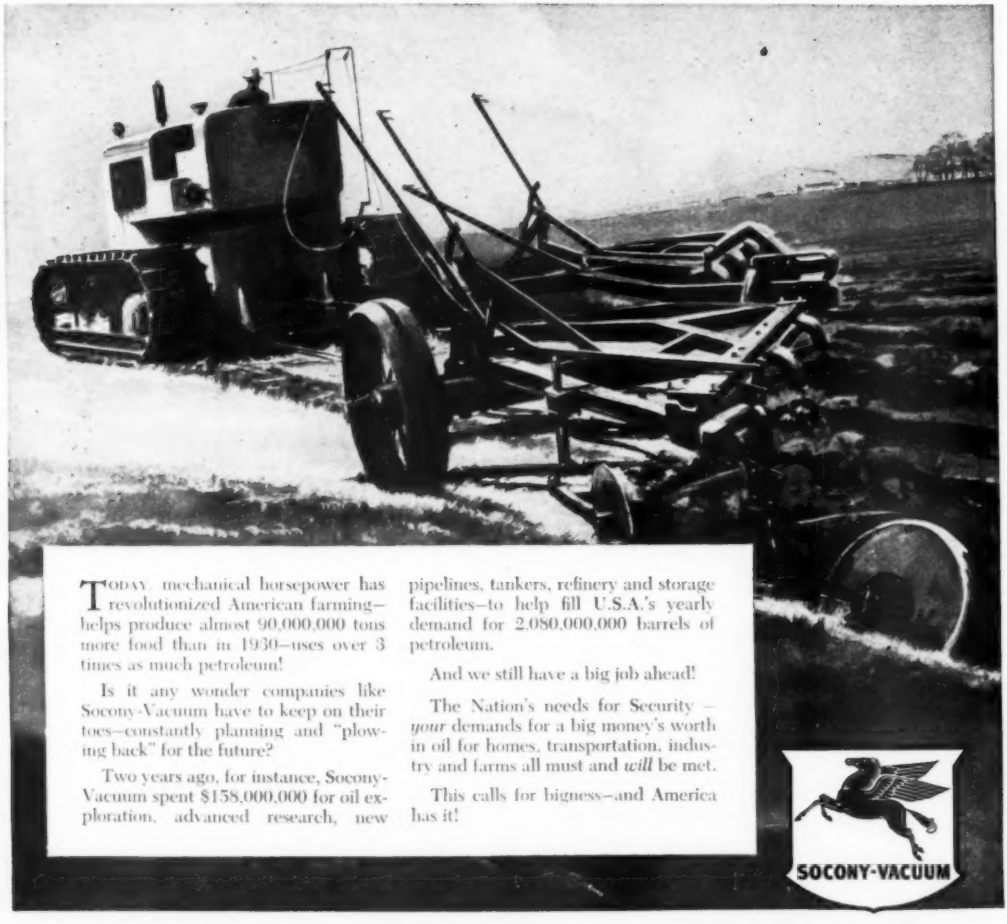
LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

DOBBIN



DOESN'T WORK HERE ANY MORE!



TODAY, mechanical horsepower has revolutionized American farming—helps produce almost 90,000,000 tons more food than in 1930—uses over 3 times as much petroleum!

Is it any wonder companies like Socony-Vacuum have to keep on their toes—constantly planning and "plowing back" for the future?

Two years ago, for instance, Socony-Vacuum spent $158,000,000 for oil exploration, advanced research, new pipelines, tankers, refinery and storage facilities—to help fill U.S.A.'s yearly demand for 2,080,000,000 barrels of petroleum.

And we still have a big job ahead!

The Nation's needs for Security — *your* demands for a big money's worth in oil for homes, transportation, industry and farms all must and *will* be met.

This calls for bigness—and America has it!

SOCONY-VACUUM

DEMAND DETERMINES BIGNESS

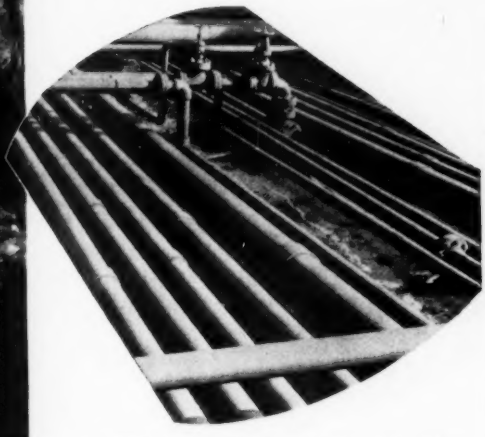
The Flying Red Horse Companies: SOCONY-VACUUM OIL COMPANY, INC., and Affiliates:

MAGNOLIA PETROLEUM COMPANY • GENERAL PETROLEUM CORPORATION

THERE'S A

REPUBLIC STEEL PIPE

FOR EVERY OIL AND GAS HANDLING NEED



ELECTRIC RESISTANCE WELDED LINE PIPE—offers the construction and operating advantages of uniform size, roundness, diameter, and wall thickness . . . uniform high yield strength . . . uniformly straight long lengths . . . ease of bending and welding . . . freedom from scale . . . inside and out inspection. The more than 59,000 miles placed in service over the past twenty years—in transmission, distributing, collecting and products lines—prove its dependability.

CONTINUOUS WELD STEEL PIPE—made under Republic's improved continuous weld process is uniformly strong, ductile, clean, and scale-free. It is uniform in wall thickness, diameter, and concentricity . . . is easy to bend, thread and close-coil . . . easy to weld by all modern methods. It comes in economical uniform long lengths, and in extra long lengths.

LARGE DIAMETER ELECTRIC FUSION WELDED LINE PIPE—high pressure line pipe in sizes 24-, 26-, and 30-inch OD. Electric fusion welded inside and out, and hydraulically expanded to uniform size, straightness and circumference. Hydraulic expansion also increases yield strength for safe handling of high pressures. Always-constant circumference and uniform wall thickness help joints line-up accurately and quickly, speed field welding.

WRITE FOR LITERATURE

REPUBLIC STEEL CORPORATION

General Offices: Cleveland 1, Ohio • Export Department: Chrysler Building, New York 17, N. Y.

Other Republic Products include Casing and Tubing—Carbon, Alloy and Stainless Steels—Studs, Bolts and Nuts—Heat Exchanger Tubes

PROCESS PUMPS *that* PAY OFF

DEAN HILL PROCESS PUMP-(TYPE BSP)

The pay-off comes in top performance . . . in long service . . . in low maintenance cost . . . in dependable, year-after-year service.

Type BSP Process Pumps are designed for the tough processing applications of the petroleum refining industry. To assure you peak performance and highest efficiency at lowest cost, Dean Hill Process Pumps are built in 12 sizes, with 24 impeller designs offering a capacity range from 10 to 1000 GPM. Get complete information and specifications. Write today for Bulletin 1050-1.

DEAN HILL PUMP COMPANY

INDIANAPOLIS 7, INDIANA

SALES OFFICES IN:
CHICAGO · MEXICO CITY · PHILADELPHIA · SALT LAKE CITY · NEW YORK · DALLAS · NEW ORLEANS · SAN FRANCISCO · DENVER · LOS ANGELES · PITTSBURGH · HOUSTON · ST. PAUL · CLEVELAND

PUMP AND TURBINE ENGINEERS SINCE 1898

Now! **TO MEET PIPELINERS' REQUIREMENTS...**

A New, More Powerful Tractor-Side Boom Combination

ALLIS-CHALMERS

HD-20

with Hydraulic Torque Converter Drive

★ ★ ★

TRACTOMOTIVE

Heavy-Duty Side Boom — 110,000-lb. lifting capacity at 4-ft. overhang.

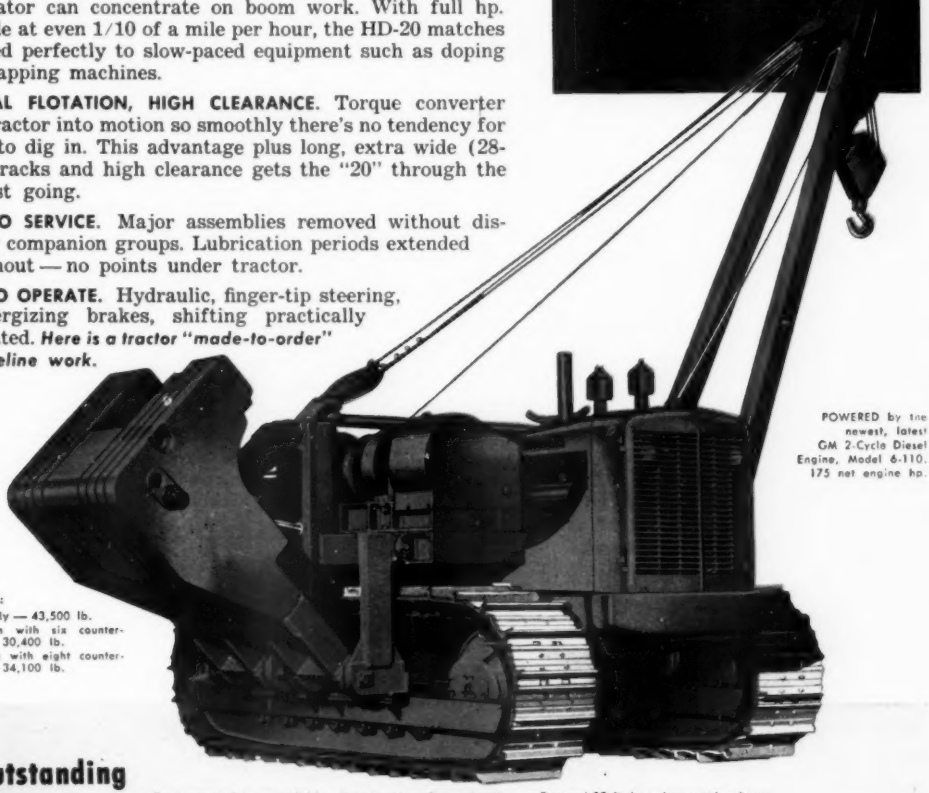
OUTSTANDING HD-20 PERFORMANCE ADVANTAGES:

HYDRAULIC TORQUE CONVERTER DRIVE provides smooth, cushioned power for tractor and boom. Eliminates most shifting — operator can concentrate on boom work. With full hp. available at even 1/10 of a mile per hour, the HD-20 matches its speed perfectly to slow-paced equipment such as doping and wrapping machines.

UNUSUAL FLOTATION, HIGH CLEARANCE. Torque converter eases tractor into motion so smoothly there's no tendency for tracks to dig in. This advantage plus long, extra wide (28-inch) tracks and high clearance gets the "20" through the toughest going.

EASY TO SERVICE. Major assemblies removed without disturbing companion groups. Lubrication periods extended throughout — no points under tractor.

EASY TO OPERATE. Hydraulic, finger-tip steering, self-energizing brakes, shifting practically eliminated. ***Here is a tractor "made-to-order" for pipeline work.***



POWERED by the newest, latest GM 2-Cycle Diesel Engine, Model 6-110. 175 net engine hp.

WEIGHTS:
Tractor Only — 43,500 lb.
Side Boom with six counterweights — 30,400 lb.
Side Boom with eight counterweights — 34,100 lb.

Outstanding Side Boom Advantages

Counterweights extendable—hug tractor when retracted. Hydraulically controlled . . . high mounted for maximum clearance.

Internal expanding brakes control load line and boom line drums. Completely enclosed for full protection from dirt and moisture.

Pin-connected, sectional frames — quick installation, easy removal.

Rugged 20-ft. long box section boom.

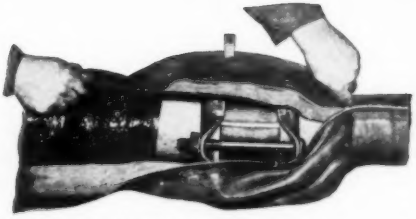
Constant mesh transmission — four speeds for load line and boom control; one reverse for power lowering.

Safety features — drop-proof counterweight linkage, cable guards in front of operator, positive locking winch controls, massive jaw clutches in winch drum drives, many others.

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

Now—you simply "pull the zipper" on corrosion problems

Dresser ZIPCOAT for welded joints zips over weld area, fits closely to the pipe. 30″ lengths.



Dresser ZIPCOAT for couplings is easy to install over joint and pipe ends—all in one quick operation. Has bleeder valve to vent air during backfilling.

NEW DRESSER ZIPCOATS* GIVE SURE PROTECTION, SUPERLATIVE DIELECTRIC STRENGTH

"As easy as zipping up a jacket" is what workmen say about Dresser's new ZIPCOATS. They install ZIPCOATS in 1/10 of the time it takes to coat a joint. You get protection that equals or exceeds that offered by the mill or yard-wrapped pipe.

And look at the hazards you avoid: there's no flame; no heating, hauling or messy application of hot stuff; no danger from fumes or burns.

Can be installed in any weather.

Write today for descriptive material and price list.

*Every ZIPCOAT complete with anaerobic microbiological corrosion inhibitor and cold sealing compound. ZIPCOAT is a trade mark of Dresser Manufacturing Division.

Dresser ZIPCOAT for insulating joints is made like the ZIPCOAT for welds, but in ten-foot lengths. Installing one on each side of an insulating joint that's protected with a ZIPCOAT for couplings gives ultimate protection. Eliminates costly boxing and filling with dope. Immediate trench backfill saves time.

Install Dresser Insulating Couplings IN MINUTES

Dresser Style 39 Insulating Couplings with new plastic gaskets insulate effectively and are the simplest insulating type joint to install. Sizes ¾″ to 30″ and up.

New Dresser Bonding Method saves up to 50% of cost; materials preformed

Fast bonding, giving low resistance with *pre*formed Dresser Bond and 5-second chemical welding method. Needs no special skill, no bulky equipment. Makes homogeneous weld area, eliminates surface contact variables. Compact kit of 50 *pre*formed bonds includes all materials needed for installing.

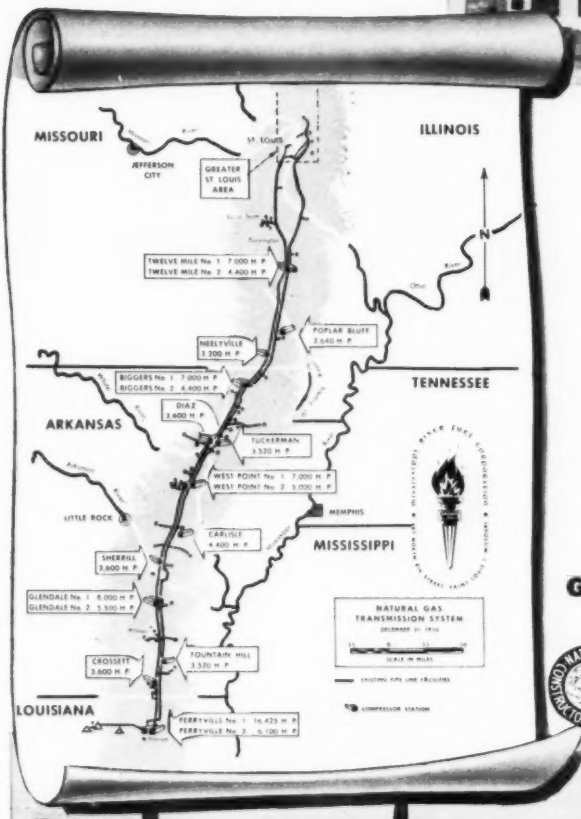
DRESSER

MANUFACTURING DIVISION

Headquarters: Bradford, Pa. (One of the Dresser Industries). Sales Offices: New York, Philadelphia, Chicago, Houston, San Francisco. In Canada: 629 Adelaide St., W., Toronto, Ontario.

GRAVER CONSTRUCTION CO. HELPS MISSISSIPPI RIVER FUEL CORP. REACH DELIVERY CAPACITY GOAL

Bonne Terre turbine station



To add to its daily delivery capacity of natural gas, Mississippi River Fuel Corp. called on Graver Construction Co. to build four compressor stations last Fall. Complete new stations were built at Tuckerman, Carlisle and Fountain Hill, Ark. A former experimental station at Wilmar, Ark. was dismantled, moved and re-erected at Bonne Terre, Mo. These additional facilities were ready in time for the winter fuel season and enabled the company to reach its required goal.

GRAVER CONSTRUCTION CO.

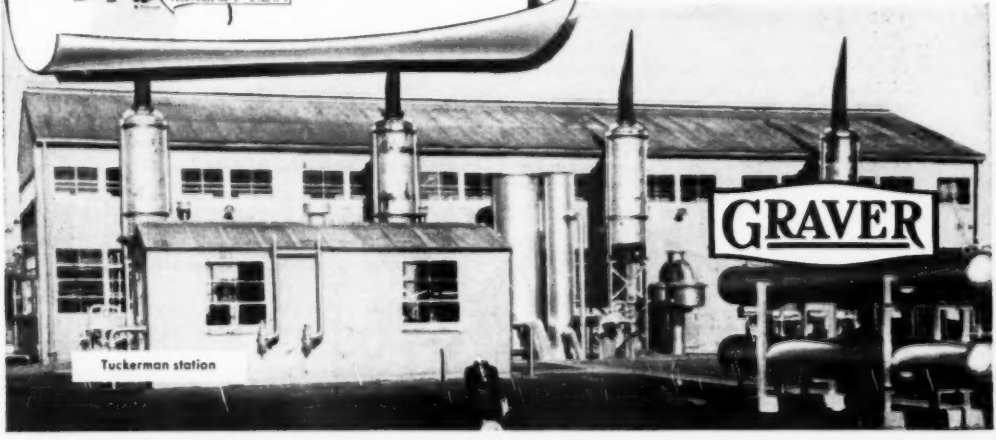
332 S. MICHIGAN AVENUE, CHICAGO 4, U.S.A.

NEW YORK • HOUSTON

A DIVISION OF

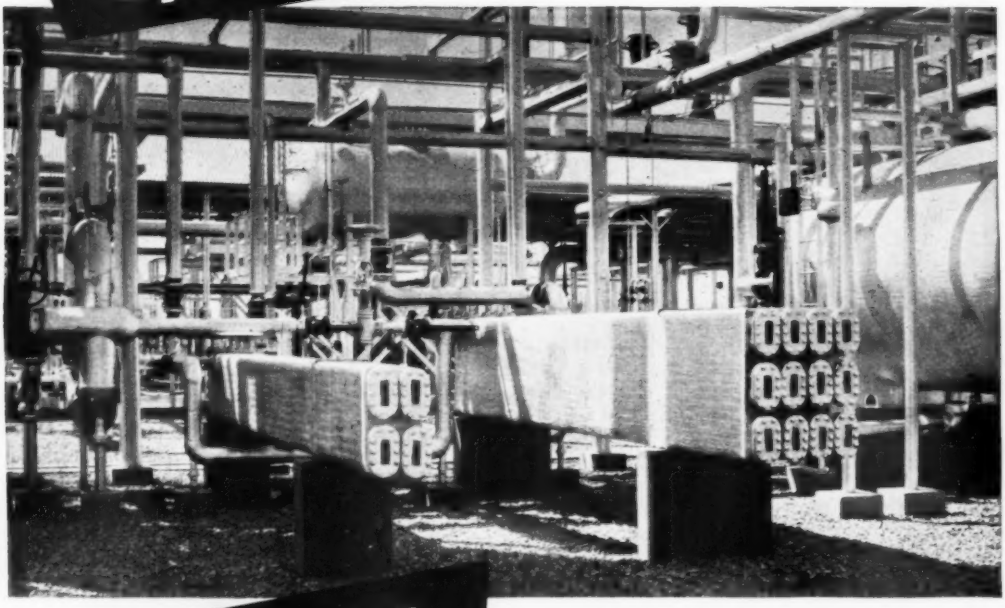
GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, IND.



Tuckerman station

Assure Continuous Operation in your plant



with BROWN FINTUBE sectional hairpin heat exchangers

● By simply manifolding an extra parallel stream into a bank of Brown Sectional Exchangers, one stream after another can be taken off-line, and cleaned, while the exchanger *operates at full capacity.*

This avoids the necessity of carrying a 100% standby unit to insure continuous operation. It permits the sections to be cleaned as frequently as the duty requires, *without affecting other parts of the plant,* and assures clean surfaces and efficient operation, year after year, without shut-down.

For utmost efficiency and economy — use Brown Fintube Sectional Heat Exchangers throughout your plant. ***Write for Bulletin No. 481.***

THE BROWN FINTUBE CO.

Elyria, Ohio

Sectional Hairpin Heat Exchangers
Tank Suction and Line Heaters
Fintube Heaters for Bulk Storage Tanks
Indirect Process Air Heaters
Fintube Heaters for Processing Tanks
Integrally Welded Fintubes for Any Heating, Cooling or Heat Transfer Service

NEW YORK • BOSTON • PHILADELPHIA • WILMINGTON • PITTSBURGH • BUFFALO • CLEVELAND • CINCINNATI • DETROIT • CHICAGO
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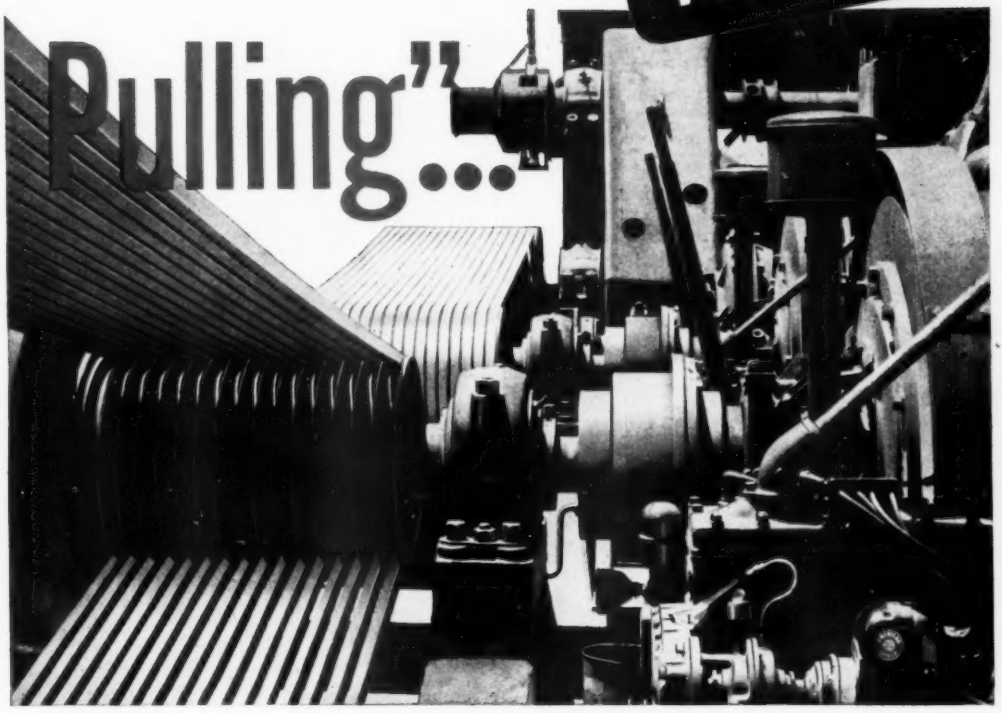
"Team Pulling"...

TEXROPE V-Belt Drives



Means Long Belt Life

YOU GET TOP PERFORMANCE and long belt life when your V-belts pull as a "team." Belts wear evenly and share the load equally. To give you V-belts you can match into sets that really carry the load together, *Texrope* V-belts are individually calibrated on a specially devised machine that shows the exact length to 1/100 of an inch.

Maintain Correct Length

The design of *Texrope* V-belts means that they will maintain their correct length — to give you even pull and increased belt life. Every belt is precision molded to run smooth, cool, and true. A tough double-wrapped cover impregnated with rubber and bias-cut for elasticity seals out dust and grit; takes the wear; protects cord structure; and keeps the belt in shape. The design, manufacture, and final testing of *Texrope* V-belts all add up to "team pulling" — and that means long belt life.

For information on all your V-belt needs, whether they be for new or replacement V-belts, standard or variable speed sheaves, call your nearest *Texrope* drive dealer, or write: Allis-Chalmers, Milwaukee 1, Wisconsin. A-3386

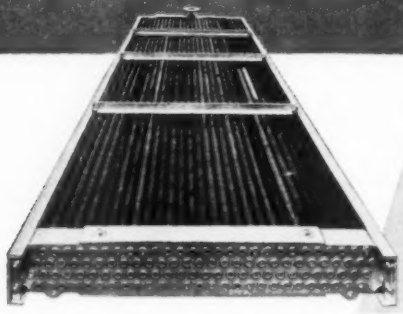
Texrope is an Allis-Chalmers trademark

ALLIS-CHALMERS A-C

Complete Stocks of Genuine *Texrope* V-belts and Drives are available at *Texrope* drive dealers located throughout the oil fields.

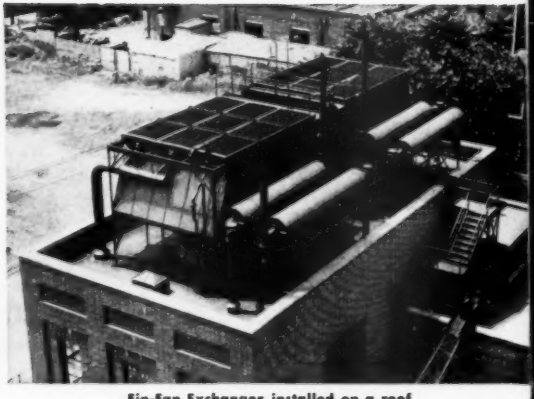
ARKANSAS — Magnolia; **CALIFORNIA** — Los Angeles; **KANSAS** — Great Bend, Plainville, Wichita; **LOUISIANA** — Houma, Lake Charles, New Orleans, New Iberia, Shreveport; **MISSISSIPPI** — Brookhaven, Laurel, Natchez; **NEW MEXICO** — Eunice, Hobbs; **OKLAHOMA** — Duncan, Edmond, Oklahoma City, Pauls Valley, Tulsa, Elk City, Ardmore; **TEXAS** — Abilene, Bowie, Dallas, Falfurrias, Fort Worth, Fullerton, Gainsville, Houston, Kermit, Kilgore, Odessa, Refugio, San Antonio, Snyder, Sundown, Wichita Falls, Midland, San Angelo, Breckenridge; **WYOMING** — Casper; **NEW YORK** — New York City.

FIN-FAN
AIR-COOLED HEAT EXCHANGER



G-R K-Fin Air-Cooled Sections used in the Fin-Fan Exchanger

Fin-Fan Exchanger installed within a building



Fin-Fan Exchanger installed on a roof

Large Fin-Fan installation on the ground

GRISCOM-RUSSELL

AIR...the only cooling and condensing medium that's...

- **FREE**
- **LIMITLESS**
- **UNIFORM**
- **DEPENDABLE**

Every plant designer, construction engineer and maintenance man knows the expenses, complications, and difficulties of water-cooled heat exchangers . . . the required piping, pumping, treatment and disposal . . . the likelihood of corrosion, scaling and freeze-ups . . . the uncertainty of sustained adequate supply.

All these problems are being avoided by plants in every section of the country which use AIR as the cooling or condensing medium . . . in FIN-FAN Air Blast Exchangers.

These exchangers, developed jointly by The Griscom-Russell Co. and Fluor Corp. Ltd., are self-contained package-type units. They include G-R K-Fin Heat Transfer Sections with Fluor air circulation equipment, all mounted in a sturdy compact structure.

You can use Fin-Fan Exchangers on practically any cooling or condensing service. You can put them anywhere . . . on the ground, on a roof, or within a building. You can use a single installation for two or more heat transfer duties.

And these are only some of the many Fin-Fan benefits and advantages. Get the whole story of this important development in heat transfer apparatus . . . write for bulletin and ask for specific recommendations on Fin-Fan for your cooling and condensing needs.

Some of the many services on which FIN-FAN EXCHANGERS are being used

- Exhaust steam condensing
- Engine jacket water cooling
- Engine oil cooling
- Oil cooling for large gear boxes, speed reducers, etc.
- Gas compressor inter and after cooling
- Process gas cooling
- Solution cooling
- Quenching oil cooling
- Still reflux condensing
- Final overhead condensing and cooling
- Refrigeration system condensing
- Gas treating and purification system condensing and cooling

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

GR-257

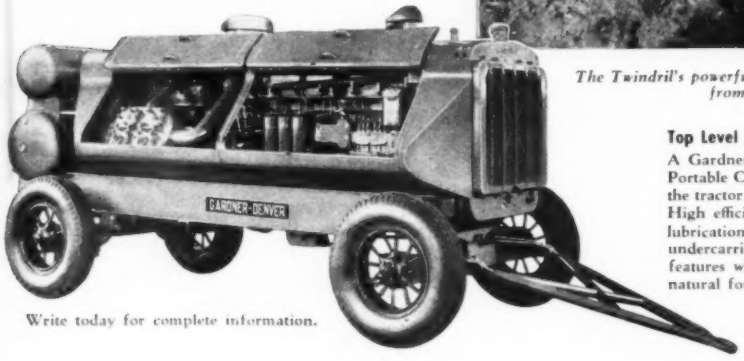
GRISCOM-RUSSELL: PIONEERS IN HEAT TRANSFER APPARATUS

WHEN YOUR PIPE LINE SCHEDULE GOES "on the rocks"

...call in the Twindril—the pipeliner's own rock drilling unit that keeps the trench on schedule when rock threatens to slow you down.

This heavy-duty rock drilling unit comes completely assembled and ready to hang from the side boom of your tractor. It drills twin holes in minutes—moves right along for the next pair of holes. Six feet of hole can be drilled with no change of steel—in any trench from $2\frac{1}{2}$ to 5 feet wide.

The Twindril's powerful 4" drills are easily controlled from ground level.



Top Level Performance—Up Hill or Down

A Gardner-Denver WBK-500D Portable Compressor is towed along behind the tractor to supply air for the Twindril. High efficiency air cleaners—positive lubrication on steep inclines—rugged undercarriage—these are a few of the features which make this compressor a natural for pipe line construction.

Write today for complete information.

SINCE 1859

GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois

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Dallas • Houston • Tulsa • St. Louis • Los Angeles • San Francisco • New York • Chicago
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Continental Supply Co., Continental Bldg., Dallas, Texas
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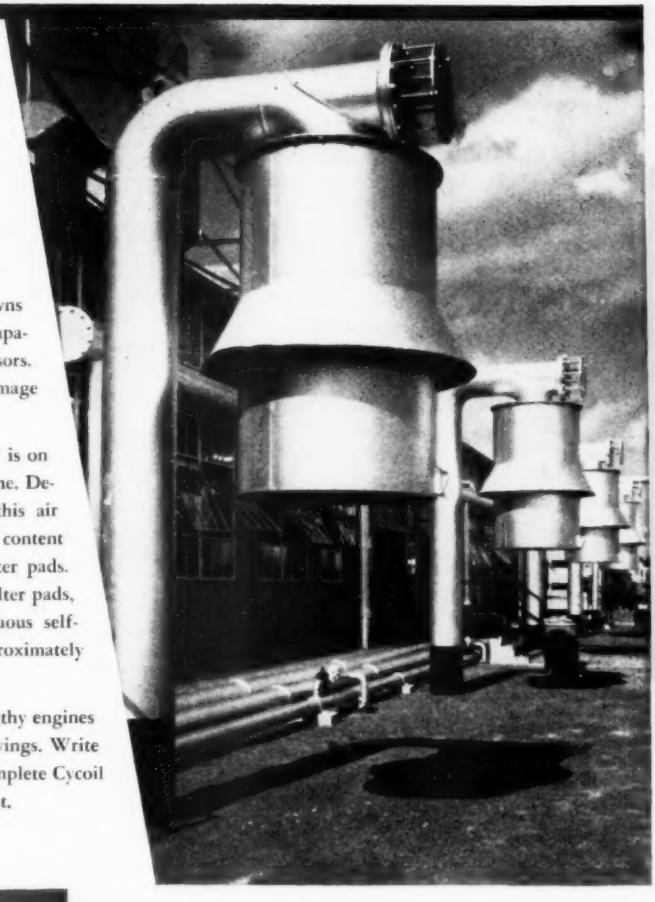
THE QUALITY LEADER IN PUMPS, COMPRESSORS AND ROCK DRILLS

"DUST DOCTORS" to Industry



CYCOIL OIL BATH AIR CLEANERS GUARD HEALTH—PROLONG LIFE of ENGINES and COMPRESSORS

Dust damage, resulting in costly shutdowns and repairs, was once accepted as an occupational disease among engines and compressors. Today, "down time" traceable to such damage is an exception rather than the rule.

The reason—Cycoil, the "dust doctor," is on the job practicing true preventive medicine. Designed to operate at 100% efficiency, this air cleaner traps over 90% of the fine-dust content of the air before it even reaches the filter pads. Thus, with added filtration of the dual filter pads, plus positive oil circulation for continuous self-cleaning action, your final result is approximately 100% clean air.

Yes, Cycoil's high efficiency means healthy engines and compressors—along with healthy savings. Write for Bulletin No. 130. It gives you the complete Cycoil story right down to the last bolt and nut.

Today's Best Buy is Better Air!

AAF

American Air Filter

COMPANY, INC.

444 Central Avenue, Louisville 8, Kentucky • Darling Brothers, Ltd., Montreal, P. Q.

News for the Southwest

ALCO Exchangers, now built in Texas

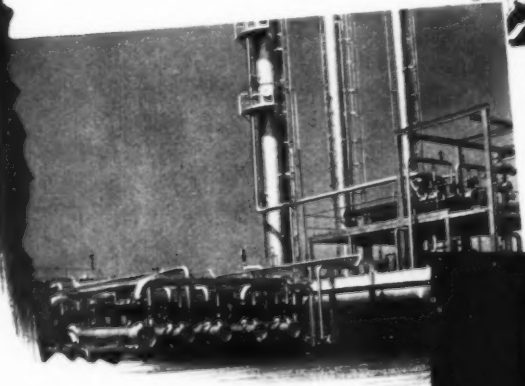
faster service, greater convenience, more time saved

At the **Beaumont Iron Works,** in the heart of the Southwest, engineers and designers who know oil, and understand its requirements, are now building ALCO heat exchangers. To the quality and dependability of these exchangers is now added the advantages of a strategic location—savings in time and greater convenience.

Put these extra values to work for you by calling in the ALCO-BIW representative when you need heat exchangers. The Beaumont Iron Works Company—Beaumont, Texas—is a subsidiary of the American Locomotive Company.

SPECIAL EXCHANGER EQUIPMENT. For years ALCO has successfully handled the problems connected with large or special heat exchanger equipment.

CAREFUL CONSTRUCTION. ALCO's long years of experience are your guarantee of quality that's built into every one of these heat exchangers.



PROVEN PERFORMANCE. In numerous installations like this large Southwestern natural gasoline plant ALCO exchangers prove their mettle in the toughest test of all—actual operation in the field.

***In step with tomorrow*—ALCO AIRCOOLERS, Heat Exchangers, Evaporators, Feedwater Heaters, Pressure Vessels, Pipe**

ALCO

ALCO Products Division
AMERICAN LOCOMOTIVE COMPANY

AGAIN— ON TIME!

Last Spring, when snow still blanketed the High Sierra of California, this trainload of Basalt-Kaiser steel pipe was speeding to meet a schedule in the Midwest . . . a schedule established by the builders of the 1300-mile Trunkline Gas Supply Company pipeline, then under construction.

The new pipeline extends from McAllen, Texas, to Tuscola, Illinois. There it connects with an existing line, and carries natural gas to middle western metropolitan centers.

The fact that this trainload of pipe—along with all the other Basalt-Kaiser pipe used on this job—was delivered *on time* is a major reason the long line was completed as scheduled in a time of difficult supply problems.

Almost every foot of the new line, which will carry 250 million cubic feet of gas per day, was made of Basalt-Kaiser pipe. In all, 259,000 tons of Basalt-Kaiser pipe was delivered to this gigantic project—*on time!*

Once again, pipeline companies have *proof* of Kaiser Steel dependability!

It's good business to do business with

Kaiser Steel

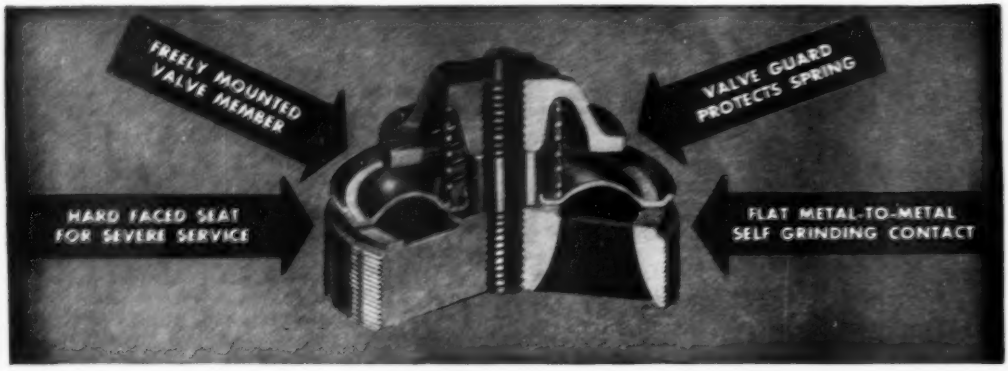
KAISER STEEL PIPE SPECIFICATIONS • All pipe manufactured to latest A.S.T.M. and A.P.I. specifications

Type	Diameter	Length	Wall Thickness	Shipping Point
Continuous Weld—Threaded and Coupled	½" to 4" nominal I.D.	Uniform 21'	Standard	Fontana, Calif.
Continuous Weld—Plain End	2⅜" to 4½" O.D.	Up to 40'	Standard	Fontana, Calif.
Electric Resistance and Fusion Weld—Plain End	8⅝" to 20" O.D.	Up to 40'	.188" to .500"	Napa, Calif.—Basalt-Kaiser
Electric Resistance Weld—Plain End	5⅝" to 12¾" O.D.	Up to 55'	.188" to .400"	Fontana, Calif.
Electric Fusion Weld—Expanded—Plain End	22" to 30" O.D.	Up to 40'	.188" to .500"	Napa, Calif.—Basalt-Kaiser

Prompt, dependable delivery at competitive prices • KAISER STEEL CORPORATION Los Angeles, Oakland, Seattle, Portland, Houston, Tulsa, New York

DURABLA

METAL PUMP VALVE UNITS
KEEP YOUR PUMPS IN SERVICE


FREELY MOUNTED VALVE MEMBER
VALVE GUARD PROTECTS SPRING
HARD FACED SEAT FOR SEVERE SERVICE
FLAT METAL-TO-METAL SELF GRINDING CONTACT

1 THEY ARE SELF-GRINDING: Durabla Valve Units*, utilizing the freely mounted arched construction valve member exclusive to Durabla, are self-grinding, as the flat portion of the valve member is in direct contact with the flat valve seat and is free to move about its axis, thus producing a constant self-grinding action.

2 VALVE SEATS ARE HARD FACED FOR SEVERE SERVICE: Providing a seat surface hardness of Rockwell C-48-52 (approximately 500 Brinnel) or more in special valves, Durabla Valve Units have a long record of effective service with FLUIDS CARRYING SUSPENDED ABRASIVE SUBSTANCES. The metal valve member effectively prevents the pitting or "pick-up" of abrasive substances sometimes occurring with valves made of other materials.

3 VALVE SPRINGS AND VALVE STEMS ARE PROTECTED: The Valve Guard protects the Valve Spring from ever compressing more than 50% of its length. The Valve Stem is protected against breakage by the free mounting of the Valve Member.

Economy, efficiency and adaptability, based on long established service records and exclusive design make Durabla Valves your guarantee of reliable, uninterrupted pump operation.

You can specify Durabla Valves when you order a pump, (many manufacturers use them as standard equipment), or you can order Durabla Valves to fit any type of reciprocating pump, (they come with drive-fit seats or threaded seats with or without a shoulder to suit the job).

TO AVOID "PUMP TROUBLES" SPECIFY DURABLA VALVES

Address DURABLA Engineering Department for information and bulletin: Reference OG-10

*Patent Numbers 2090486, 2117504

DURABLA MANUFACTURING COMPANY
114 LIBERTY ST. NEW YORK
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Bingham

PRECISION BUILT FIELD PROVEN PUMPS

"Double Volute" MULTI-STAGE Pumps

Bingham Multi-Stage Pumps are of "Double Volute" design, insuring perfect radial balance — unusually short spans between bearings — case bolts uniformly located close to shaft centerline — integral crossovers producing casings of maximum strength for high pressure service.

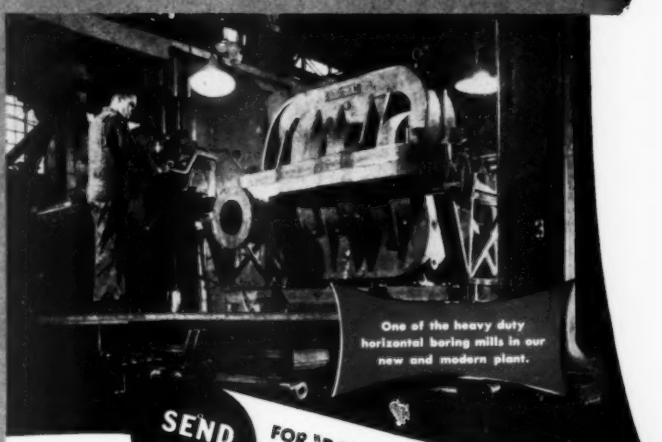
Bingham "Double Volute" Multi-Stage Pumps have been field proven for such high pressure service as *Pipe Line Booster Stations, Cold Charge Pumps, Boiler Feeders, Lean Oil Circulation*, and other applications requiring the utmost in sustained efficiency and low maintenance.

• • •

It takes Big Precision Tools like these to Build Pumps like this

Bingham Multi-Stage Pumps, like all Bingham products, are precision built in our new and modern plant. All rotating parts are dynamically balanced. All parts requiring close tolerances are ground on heavy duty precision grinders. Each part is subjected to rigid inspection by craftsmen who for years have been trained to follow Bingham's high standards of manufacture.

A typical booster station on Magnolia Pipe-Line Co.'s 20-inch line equipped throughout with Bingham "Double-Volute" multi-stage pumps.



One of the heavy duty horizontal boring mills in our new and modern plant.

SEND NOW FOR "DOUBLE VOLUTE" treatise describing the principle and advantages of Bingham "Double Volute" pumps.

Bingham — DOUBLE VOLUTE RADIAL BALANCE — PUMPS SINCE 1921

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Portland, Oregon

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"The Commissar lies, I heard the truth from Radio Free Europe!"

Picture posed by patriotic Americans

Radioed truth is reaching behind the Iron Curtain! The cold war must be won!

Talk! Talk! Talk! Lies! Lies! Lies!

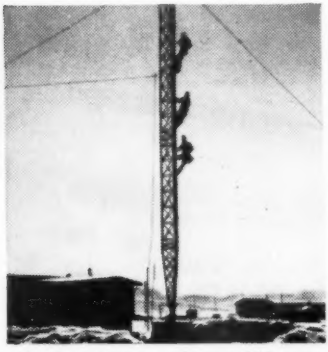
Communist propaganda is falling on deaf ears behind the Iron Curtain — and the reason is *you!*

Your dollars have built two vital radio transmitters on the very doorstep of Red dominated Europe. Daily, Radio Free Europe is beaming the truth to millions under Kremlin rule. These broadcasts are countering Communist fiction with fact... helping to win the *cold* war for all of us.

And the Commies can't stop them.

But there's more to be done... more *you* can do.

Two More Powerful Transmitters Urgently Needed. Radio Free Europe now operates two Freedom Stations in Western Germany. The Munich Transmitter—the free world's most powerful medium-wave transmitter—blankets Czechoslovakia daily. The Frankfurt Transmitter reaches six Iron Curtain countries... but only 1½ hours a day each. NOW at least two more powerful transmitters are needed to reach other millions behind the Iron Curtain. Only your dollars—your contributions to the Crusade for Freedom—can build these truth stations.



RADIO FREE ASIA, too, needs your aid in starting similar truth broadcasts to the Far East ... to halt the spread of Communism in Asia!

Help Truth fight Communism— Give to the Crusade for Freedom

Empire State Building, N. Y. 1, N. Y.

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Run in the Public Interest

GULF OIL CORPORATION • GULF REFINING COMPANY

Long heat exchanger tube life starts here!

CHASE ANTIMONIAL ADMIRALTY

(A patented alloy)

Thousands of installations since 1935 prove that Chase Antimonial Admiralty* adds years of service to heat exchanger life.

Chase Antimonial Admiralty has *enough* antimony to resist dezincification. And antimony does not lessen resistance to other forms of corrosion . . . keeps tubes tough and rugged under heavy-duty assignments.

FREE BOOK — Send for the new Chase book discussing problems of corrosion in condenser and heat exchanger tubes, selection of proper alloy, and information on installing tubes. Fill in coupon below.

*U. S. Patent No. 2,061,921

NEW BOOK includes Specifications, Weights, Dimensions and other data.

SPECIAL STOCKS OF ANTIMONIAL ADMIRALTY TUBES are carried in our NEW YORK, BALTIMORE, NEW ORLEANS, LOS ANGELES Warehouses. *Also carried by* Vinson Supply Co., Tulsa, Standard Brass & Mfg. Co., Houston.

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Please send me your free book on Condenser and Heat Exchanger Tubes.

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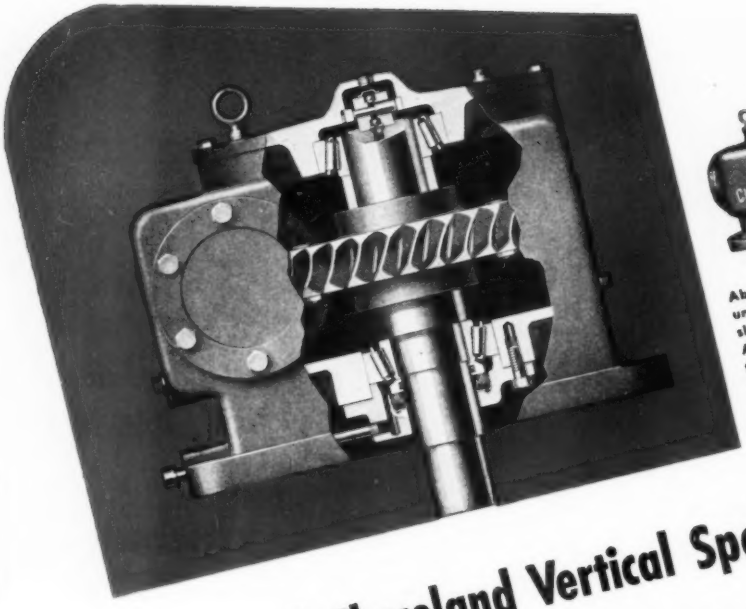

Above—Exterior view Type ND unit. NU unit (not shown) has slow-speed shaft extending up. At left—Cutaway section to show tapered roller bearings on gear shaft, positive face-type oil seal, unique lubricating pump and oil drain at base of housing.

A new series of Cleveland Vertical Speed Reducers

● NU and ND worm gear units—in seven sizes each (50 to 500) are ready for prompt delivery. They are particularly suited to such equipment as agitators and mixers, and to overhead chain conveyors as well.

Outstanding features which insure that these new vertical drives will deliver long and trouble-free service are:

Extra heavy tapered roller bearings on gear shaft.

Continuous lubrication of top bearing by positively driven pump mounted on upper end of gear shaft (on lower end in Type NU).

Positive face-type oil seal below lower gear shaft bearing to prevent leakage.

Heavy base flange extends around all four sides. All parts liberally sized and precision built.

Write for Bulletin 125 for full description of Types NU and ND, including capacity charts and dimension data. The Cleveland Worm & Gear Co., 3286 East 80th Street, Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers, Limited.

GET THESE *Outstanding Features* IN YOUR NEXT DIESEL

- ✓ "TRUE" DIESEL OPERATION
- ✓ UNIT FUEL INJECTION
- ✓ FOUR VALVES PER CYLINDER
- ✓ HYDRAULIC SERVO-TYPE GOVERNOR
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- ✓ INTERLOCKING CONNECTING RODS
- ✓ DUAL OVERHEAD CAMSHAFTS
- ✓ FLYWHEEL END CAM DRIVE
- ✓ EXTRA HEAVY CRANKSHAFT
- ✓ SYMMETRICAL DESIGN

ONLY MURPHY DIESEL HAS THEM ALL and they mean more power . . . greater fuel economy . . . less down time . . . longer engine life. A complete description of all these features and many others—and what they mean to you—is given in the booklet "*10 Questions to Ask a Diesel Engine Salesman*". Ask your Murphy Diesel Dealer for a copy or write direct.

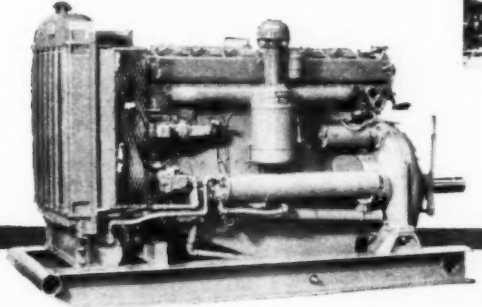
MURPHY DIESEL COMPANY

5305 W. Burnham St. Milwaukee 14, Wisconsin

OIL INDUSTRY FACTORY BRANCH Sales, Part Service:
113-117 South Elwood Street, Tulsa, Oklahoma

Sales, Parts and Service: Los Angeles, California; Evansville, Indiana; Great Bend, Kansas; Monroe, Louisiana; Tulsa, Oklahoma; Amarillo, Dallas, Houston, Odessa and San Antonio, Texas; and Edmonton, Alberta, Canada.

Rig of the Aztec Drilling Co., Aztec, New Mexico, which at the time this photo was made, was being used to drill a gas well near Lindreth, N. M. The rig is powered by three 150 H.P. (continuous) Murphy Diesels.



Heavy duty power for the oilfields

Murphy Diesel Engines and Power Units for drilling and pipe line pumping, 90 to 226 H.P., 1200 and 1400 RPM. Generator Sets, 60 to 140 K.W. Dual-Fuel Engines, 135 to 180 H.P. Also Crude Oil Burning Engines.

MURPHY DIESEL

Wrap 'er up

...with FIBERGLAS*

Check these three questions when you pick the wrap for that next pipeline job . . .

Will it reinforce the enamel to give maximum protection? Fiberglas COROMAT does it!

Will it protect enamel from soil stress, backfill impact, rough handling? Fiberglas Pipeline OUTER WRAP does it!

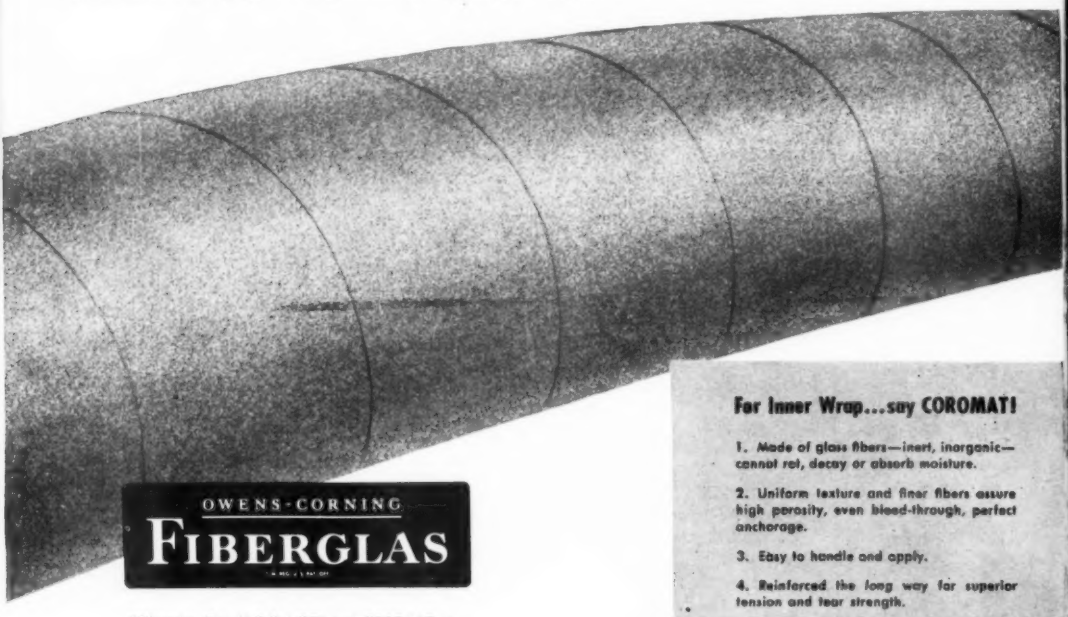
How fast will it go on? Actual field experience proves that strong, tough Fiberglas wrap can be applied up to 50% faster than ordinary materials.

Read that last point again. Think what it means. Less time to do the job. More effective use of manpower and equipment. So, with Fiberglas wraps, you can give your pipelines the most effective protection . . . and you get it faster!

Take a look below at the advantages you get with Fiberglas Double Wrap . . . COROMAT and OUTER WRAP. You'll see why we get so many repeat orders at Wrap Headquarters! OWENS-CORNING FIBERGLAS CORPORATION, Dept. 54-J1, Toledo 1, Ohio.

FREE SAMPLES! Write us, on your letterhead, for complete information and free samples of Fiberglas wrap materials.

The best aid to corrosion protection is GLASS. Owens-Corning pioneered glass wraps . . . now offers the only complete glass Double Wrap system, engineered specifically for the job.



OWENS-CORNING
FIBERGLAS

*Fiberglas (Reg. U. S. Pat. Off.) and COROMAT are trade-marks of Owens-Corning Fiberglas Corporation for products made of or with fibers of glass

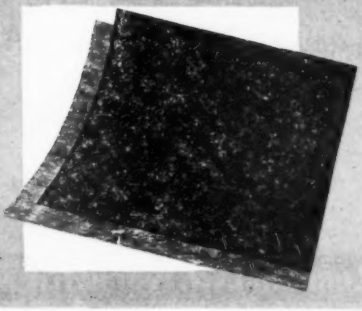
For Inner Wrap...say COROMAT!

1. Made of glass fibers—inert, inorganic—cannot rot, decay or absorb moisture.
2. Uniform texture and finer fibers assure high porosity, even bleed-through, perfect anchorage.
3. Easy to handle and apply.
4. Reinforced the long way for superior tension and tear strength.
5. Retains full strength under hot application.
6. Longer rolls and virtually no breaks give more miles wrapped per day.

1/3 faster

COROMAT* AND OUTER WRAP

Protect the corrosion protection with Fiberglas OUTER WRAP!



1. Exclusive glass-and-bitumen construction cushions backfill impact, soil stresses, bumps.
2. Strong, reinforced COROMAT core permits fast, break-free wrapping.
3. Porosity releases trapped gases, permits keying enamel to outer wrap, minimizes holidays.
4. No wicking action to absorb moisture or draw off rich protective oils.
5. Applies snugly around any bend a wrapping machine can travel.
6. No moisture pickup during storage or application.
7. Reflective surface helps enamel to set up faster in hot weather.

up and up and up go Harvey Columns

Fabricated in London, erected in Holland, another Harvey Flash Fractionating Column takes its place in the vast new Royal Dutch Shell Refinery, at Pernis, where present day world demand for Oil and all its products is rapidly being met. Harveys were able to undertake this work because they have one of the most modern and completely equipped works in the world—operated by an experienced staff specialising in this and other types of fabrication for the Oil and many other Industries. **In fact Yours the problem – Harveys the answer!**

FABRICATORS **Harvey** IN METAL

G. A. Harvey & Co. (London) Ltd. Woolwich Road, London, S.E.7

no lubrication worries and expense

no product contamination or clogging of meters

easy, trouble free operation

ALL THIS AND MORE TOO, WITH THE

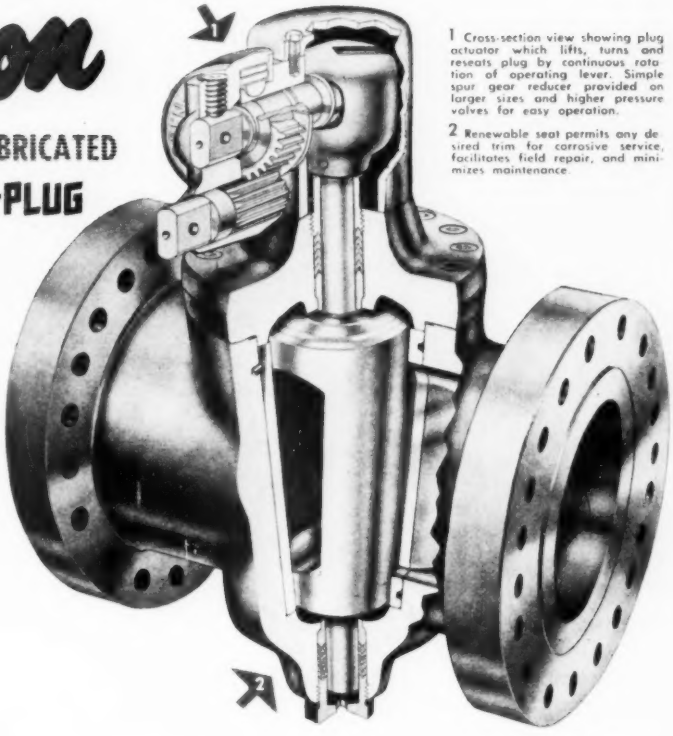
Cameron

NON-LUBRICATED LIFT-PLUG

PIPELINE VALVE

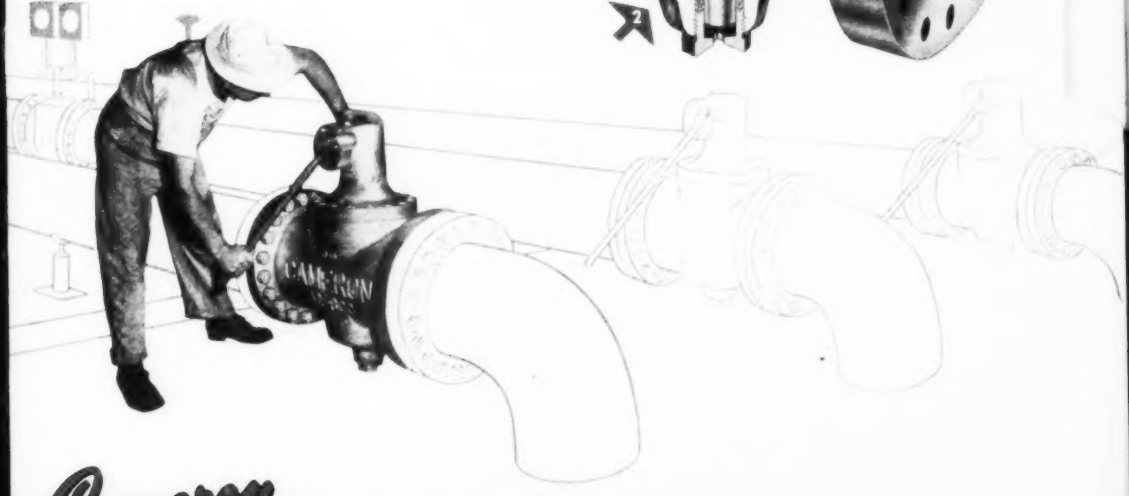
Here's everything you could wish for in a pipeline valve: A tight closure and easy operation without the headaches that come with lubrication. No product contamination. No grease to buy. No man hours for lubrication maintenance. No clogging or fouling of orifice plates and straightening vanes by valve lubricants.

Study the design shown at right. Note its unique mechanical features. Then put these remarkable valves in your service and get first-hand performance data.



1 Cross-section view showing plug actuator which lifts, turns and reseats plug by continuous rotation of operating lever. Simple spur gear reducer provided on larger sizes and higher pressure valves for easy operation.

2 Renewable seat permits any desired trim for corrosive service, facilitates field repair, and minimizes maintenance.



Cameron IRON WORKS, INC.

P. O. BOX 1212, HOUSTON, TEXAS

Export: 74 Trinity Place, New York, N. Y. Represented in the sterling area by: British Oilfield Equipment Co., Ltd., Duke's Court, St. James's, London S.W.1, England.

This Simple Compressor Meets the Complex Needs of a Changing Petroleum Industry

It's the Nash!

Here is a compressor presenting advantages found in no other device. Nash Compressors have only one moving part, rotating without metallic contact with the pump casing. No internal lubrication is required. Yet they produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure.

There are no valves, gears, pistons, sliding vanes, or other complicated wearing parts in a Nash. Compression is secured by an entirely different principle of operation. Because of this, gas pumping problems difficult with ordinary pumps are often easily handled by the Nash. For example, Nash Pumps are standard equipment in the Synthetic Rubber Industry, where they have met the needs of new and difficult processes.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. They maintain original performance over long periods. Service is assured by a nationwide net-work of Engineering Service offices. Instructive bulletin shows how they operate. Write for it.

One moving part.

No internal wearing parts.

No valves, pistons, or sliding vanes.

No internal lubrication.

Low maintenance.

Slugs of liquid entering pump do no harm.

Non-pulsating pressure.

Saves floor space.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

273 WILSON, SO. NORWALK, CONN.

"THE PRICELESS INGREDIENT..."

For years E. R. Squibb & Sons have said: "The priceless ingredient of every product is the honor and integrity of its maker."

That makes a lot of sense.

Every length of pipe coated by Hill, Hubbell bears our name on the outer wrapping. This is the "priceless ingredient"—your assurance that the leader, with a quarter century of experience in pipe protection, did the job and stands behind it.

P.S. To our pipe coating plants at Girard and Lorain, Ohio, we have added a third at Hammond, Indiana—centered in the steel pipe mill section of the Chicago Switching District. This location enables our customers in the west and southwest to take advantage of the Hill, Hubbell process with faster deliveries. Minimum freight rates include the privilege of coating and wrapping pipe in transit. The new plant has ample storage space.

Hill, Hubbell and Company

Division of GENERAL PAINT CORPORATION

Headquarters: 3091 Mayfield Road, Cleveland 18, Ohio

Leaders in Pipe Protection for a Quarter Century

COLUMBIAN

BOLTED STEEL TANKS

"Buy Word" of Oil Producers Everywhere!

Year in and year out the name "COLUMBIAN" continues to be the "buy word" with oil producers in every part of the world. Whether the requirement is for single small units for special storage, or a battery of large capacity, COLUMBIAN BOLTED STEEL TANKS meet the need in a money saving way. Columbian's 58 years of experience in precision engineering and fabricating tanks assure years of trouble free service. You'll also appreciate the many exclusive construction features that make COLUMBIAN TANKS easily assembled by unskilled labor. Make "COLUMBIAN" your "buy word" in tanks and you buy the best!

COLUMBIAN STEEL TANK COMPANY — TANKS FOR THE WORLD

COLUMBIAN STEEL TANK CO. — K.C. MO. — COP-NIC — COPPER NICKEL ALLOY — TANKS FOR THE WORLD

Rigid • Strong • Fire-Safe • Low Upkeep

COLUMBIAN ALL-METAL BUILDINGS are "naturals" for long-lasting, protective storage of equipment of all kinds. Easily assembled . . . easily knocked-down and re-assembled without damage. Ideal for warehouses, engine houses, garages, etc. Minimum upkeep cost for years on end.

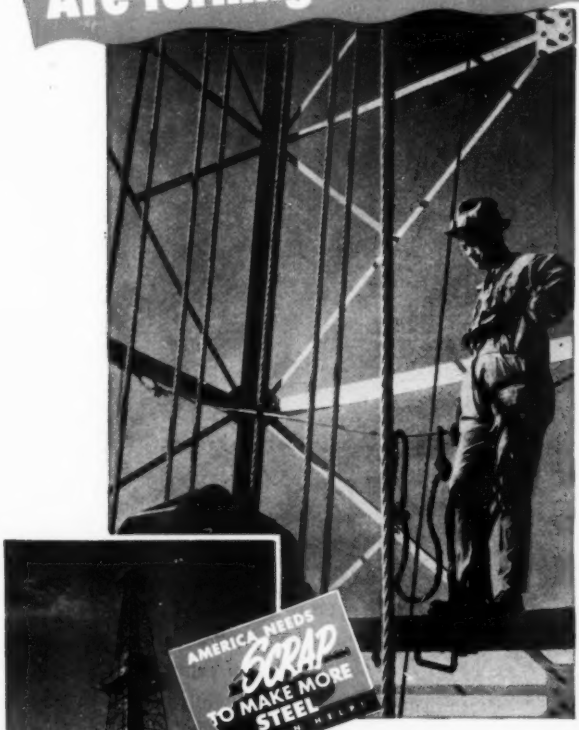
COLUMBIAN STEEL TANK CO., P. O. Box 4226-H, Kansas City, Mo.

Drillers Who Know Their 3 C's

- COST of Replacement
- COST of Downtime
- COST of Operating

J&L STEEL

Are turning to J&L Wire Rope



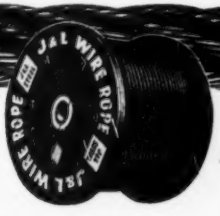
It doesn't take a wizard at mathematics to figure out that low operating costs mean economical operation and higher profits. That's why more and more smart drillers throughout the oil country are ordering J&L drilling lines for their rotary or cable tool rigs. Experience has proved that they'll get maximum service life—maximum hole per wire rope dollar with J&L.

The long service life of J&L Wire Rope is due to J&L's "quality controlled" method of manufacture. "Quality control" ensures the finest finished product by controlling every step in the manufacture of the wire rope from the mining of the ore to the final stranding and closing operations.

The result—long service life on the job, that's reflected on the balance sheet in low cost for wire rope, minimum downtime for rerigging and less man-hours spent installing new lines—in short, lower operating costs.

In addition, the popularity of J&L Wire Rope in the oil country is built on more than long service life. The men on the rigs like it too because it's easy to handle, spools smoothly, and is lubricated with J&L's exclusive Bronze-lube—the lubricant that's clean to handle, doesn't run out when the line gets warm.

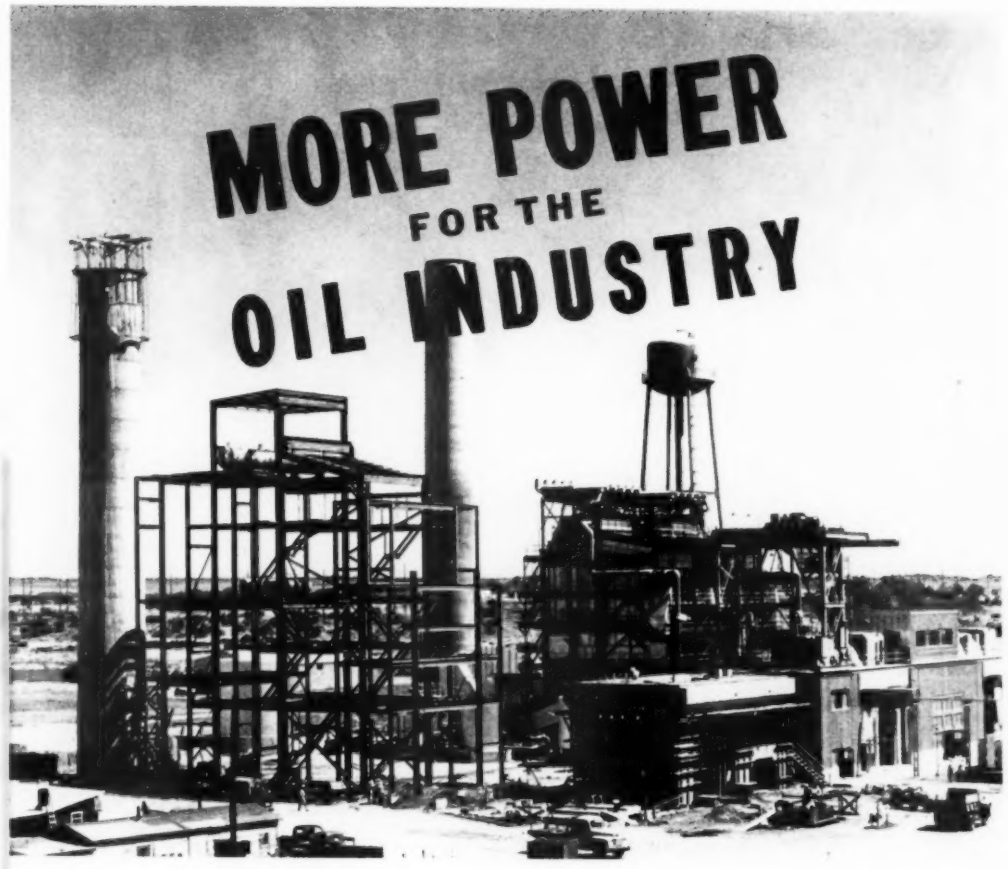
If you're not already using J&L drilling lines, it will pay you to find out more about J&L quality controlled Wire Ropes. Why not contact your nearest J&L Wire Rope representative today?



JONES & LAUGHLIN STEEL CORPORATION

From its own raw materials, J&L manufactures a full line of carbon steel products, as well as certain products in OTISCOLOY *and* JALLOY *(hi-tensile steels).*

PRINCIPAL PRODUCTS: HOT ROLLED AND COLD FINISHED BARS AND SHAPES • STRUCTURAL SHAPES • HOT AND COLD ROLLED STRIP AND SHEETS • TUBULAR, WIRE AND TIN MILL PRODUCTS • "PRECISIONBILT" WIRE ROPE • COAL CHEMICALS



Since 1945, we've more than tripled our power generating capacity — from 121,000 to 374,275 kilowatts at the end of 1950. New plants totaling 124,000 kilowatts are scheduled for 1952. New transmission lines, substations and distribution systems round out the most ambitious building program in the company's history.

The power system of Texas Electric Service Company has for many years supplied electric power for well pumping, pipe line pumping, refining and well drilling in many West Texas oil fields. Electric power, through these many years, has been one of the greatest single aids in the development of West Texas' oil potentials.

Shown above (background) is the 44,000 kilowatt Morgan Creek steam-electric generating station of Texas Electric Service Company located near Colorado City, in the heart of the most active oil producing and oil transportation development in the mid-continent area. A second 44,000 kilowatt unit (foreground) is under construction, scheduled for completion next year.

TEXAS ELECTRIC SERVICE COMPANY

ASSURE ACCURACY IN YOUR GAS DEVELOPMENTS

When you use AC-ME and R.S. Specialties
you can guarantee accurate tests and measurements.

Manufacturers of these Instruments:

CEMENT TESTING INSTRUMENTS
- Super Pressure Consistometer
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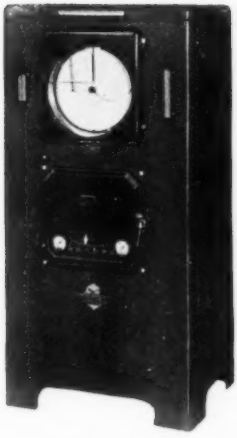
CORE TESTING INSTRUMENTS
- Core Cutting Knife
- Laboratory Core Drills
- Porosimeter-Stevens Type
- High-Pressure Flood Pats

GAS TESTING INSTRUMENTS
- Recording Gravitometer
- Specific Gravity Balance
- Dew Point Tester
- Super Compressibility Apparatus

DEAD WEIGHT INSTRUMENTS
- Standard Dead Weight Gauge
- Portable Dead Weight Tester

LIQUID TESTING INSTRUMENTS
- Liquid Gravitometer
- Vapor Pressure Bombs
- Pressure Hydrometer Jar
- Specific Gravity Bombs
- Corrosion Test Bombs



AC-ME Recording Gravitometer-Controller

AC-ME Recording Gravitometer

Write today for your copy Bulletin No. 50 Describing R.S. and AC-ME Testing Instruments.

R.S. Dead Weight Gauge

Large stocks of laboratory apparatus and supplies for oil and gas testing are available for your convenience.

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Laboratory Apparatus and Supplies *Oil and Gas Testing Equipment*

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CRANE VALVES . . .

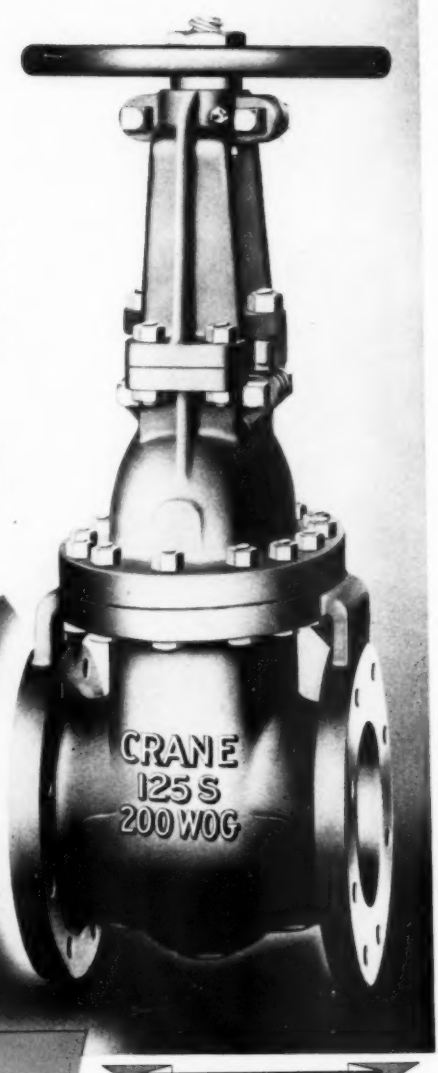
For the Oil Country
Stocked by

VINSON

Valves bought today will have to work more dependably and stay in service longer. Never has it been more important to insist on CRANE QUALITY—the best in valves. We carry a complete line of Crane Valves for refinery, gasoline plant, pipeline, chemical and general industrial requirements . . . all types, sizes and pressure ratings. Write for our bi-monthly Crane stock list. MORE CRANE VALVES ARE USED THAN ANY OTHER MAKE.

VINSON LINES

Crane Valves • Ladish Welding Fittings and Flanges • Fisher Controls • Nordstrom Valves • Chase Brass Tubes • National Pipe and Steel Tubes



VINSON FOR VALVES

Vinson Supply COMPANY

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TULSA – 5-6681, L.D. 717
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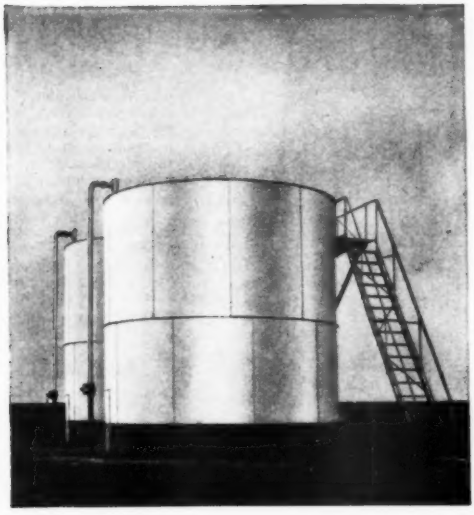
Dependable Service *always*

from BUTLER Bolted Steel OIL TANKS



Every time you need safe, strong storage for petroleum products, remember Butler. Remember the extra care and skill that Butler puts into bolted steel tank engineering and fabrication.

Butler makes certain that you always get long, dependable service from your tanks. Each tank part, for example, is accurately engineered ... tank sheets are formed on precision dies ... and precision punched to insure an oil-tight fit and faster, easier erection. Each part is gaged and tested during fabrication to make sure that stresses are divided equally on all bolts when the tank is loaded. Electrostatic painting puts a uniform protective coating on all parts.

Whether you need a single tank or a battery ... if you want dependable storage service, next time call your Butler distributor for Butler Bolted Steel Tanks.

Dependable Service *always*

from Your Butler Distributor

You can always get dependable, responsible service on Butler Bolted Steel Tanks from your Butler distributor. He can also give you information or service on: Walkways, Stairways, Unit Heaters and other oil field equipment.

AMERICAN PIPE & SUPPLY COMPANY
Casper, Wyoming
Denver, Colorado
Cut Bank, Montana

HARRY G. MILLER
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UNION TANK & SUPPLY COMPANY
Fort Worth, Texas
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BUTLER

BUTLER MANUFACTURING COMPANY
Kansas City, Mo.
Galesburg, Ill. Richmond, Calif. Birmingham, Ala. Minneapolis, Minn.

Longer service in corrosive wells with...

Sucker Rods of "K" Monel

"K"® Monel sucker rods have lasted for *years* in wells where other rods have failed in *weeks*.

In some of the most corrosive areas of West Texas, for example, "K" Monel rods have bucked a wide range of sour crudes and brines—*and won out every time.* (Three typical case histories are briefly reviewed in the panel at the right.)

"K" Monel, in addition to providing such high resistance to corrosive media, also resists abrasion and wear. It withstands stress, vibration and flow-cutting.

High Fatigue Strength

And "K" Monel has other important features, too. It can be used under the conditions existing in oil and gas wells without significantly accelerating corrosion of the steel equipment with which it comes in contact. Nor is its fatigue strength significantly affected by the presence of oil well corrosives.

Heat-treatable and non-magnetic, "K" Monel's tensile strength can be developed to 140-170,000 psi, and its hardness to 25-35 Rockwell "C." Thus you get strength and hardness comparable to heat-treated alloy steels—and you have all the corrosion-resisting, wear-resisting properties of "K" Monel besides!

Right now, of course, *Inco* Nickel Alloys are being diverted more and more to defense production. That's why you may have to wait for the "K" Monel you want.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

"K" MONEL...
YOUR PARTNER IN PROGRESS

EMBLEM OF SERVICE
INCO

Compare these PROBLEMS with yours!

Case No. 17

Location: Particularly corrosive well.

Problem: A sucker rod break every 50 days. Entire string needed replacement every 5 months.

Solution: Installed a 2300' x ¾" "K" Monel sucker rod string. At last report—almost seven years after installation — string had operated continuously 2,397 days without a corrosion break.

Case No. 21

Location: This well called "one of the worst in the area."

Problem: An average of 2 rod breaks a week. High fishing and pulling costs. Production loss.

Solution: "K" Monel string installed. At last report had gone 32½ months without a single corrosion break. (Satisfied operators ordered another string, after estimating previous string would have had 260 breaks in same time.)

Case No. 46

Location: Corrosive well.

Problem: Average one break a week. Economical production nearly impossible.

Solution: Installed "K" Monel string. No evidence of corrosion after 30 months' steady use. Operator completely satisfied with improved performance.

STANDARD OIL CO., (N. J.)
photo by Lee

PACIFIC'S

"Thirty Six-Fifty One"

Pacific's Fig. No. 3651, 600 Lb. Cast Carbon Steel Gate Valves fill the need for small size, low cost valves for high pressure service. These valves are ruggedly constructed for heavy duty service, yet light in weight and compact for operating in limited spaces. Considerable savings in cost are possible because of Pacific's volume production methods, using the most modern high speed machinery and advanced assembly and testing methods. Only the finest of materials available are used in their manufacture, rigidly tested to meet Pacific's specifications. All component parts are machined to unusually close tolerances and are carefully inspected for imperfections. After careful assembly, each valve is tested to prescribed tests—up to as high as 2100 p.s.i., before being certified to have a Pressure Temperature Rating of 600 Lbs. at 900°F.

A careful study of the sectional view at the right, will point out many features usually found only in the larger size, more expensive, valves: (1) The bolted body-bonnet connection is a male-female joint, gasketed with a soft-iron gasket; (2) Large, deep, stuffing box accommodates many rings of packing; (3) Backseating when the valve is full open permits packing adjustments in service; (4) The wedge is fully guided; (5) The Yoke Sleeve is of Nickel Alloy with a high melting point; (6) The Handwheel is never in bearing — it rides high on the Yoke Sleeve preventing possible binding due to atmospheric corrosion. These features and many more make Pacific Valves worthy of your serious consideration.

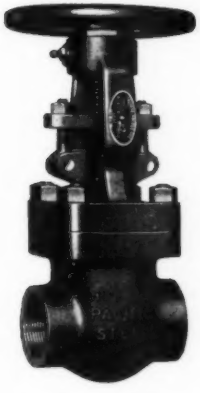

FIG. NO. 3651

These valves can be furnished with Socket Welding Ends (not illustrated). When ordering specify Fig. No. 3652. Flanged valves will be furnished with line flanges to meet A.S.A. specifications with a ¼" raised male face.

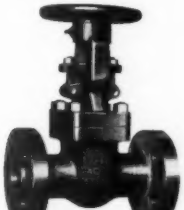

FIG. NO. 3650

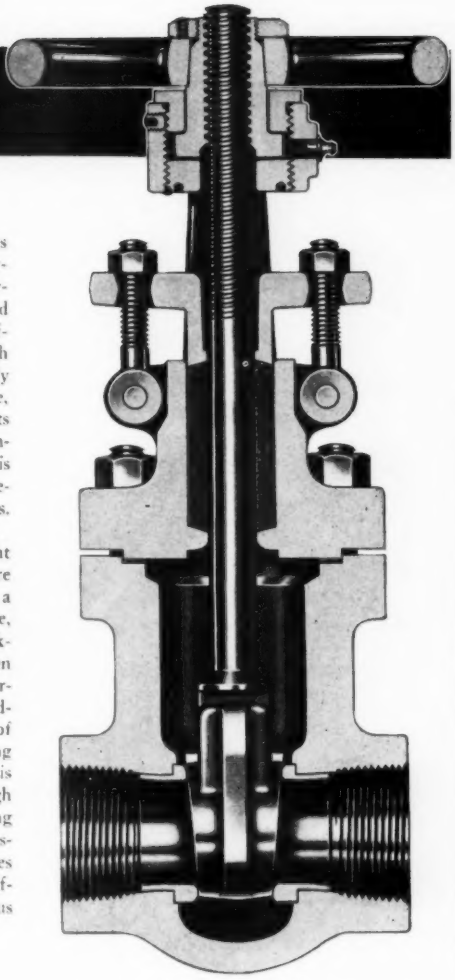

FIG. NO. 3651

Pacific's line of small size 600 Lb. Cast Carbon Steel Gate Valves are available in three distinct types: (1) O.S.&Y., Bolted Bonnet (featured in this ad) designated Fig. No. 3650 - Flanged Ends, 3651 - Screwed Ends and 3652 Socket Welding Ends—available in sizes from ¼ to 2 inch; (2) O.S.&Y., Union Bonnet, designated Fig. No. 55 - Screwed Ends and 56 - Socket Welding Ends—available in sizes from ½ to 2 inch; (3) Inside-Screw, Union Bonnet, designated Fig. No. 65 - Screwed Ends and 66 - Socket Welding Ends — available in sizes from ¼ to 2 inch inclusive.

The 3650 line is available from stock in 8 types of Body - Bonnet materials and 12 types of Trim materials.

WRITE FOR SALES BULLETIN C. S. 600 FOR ADDITIONAL INFORMATION

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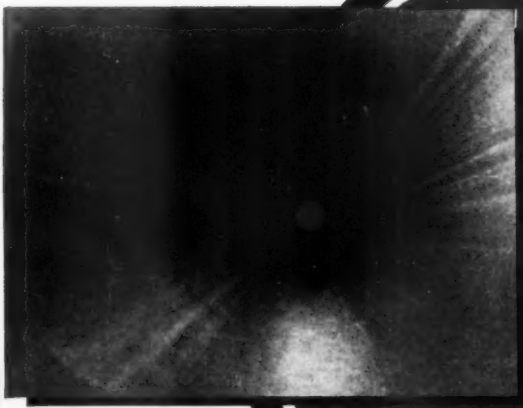

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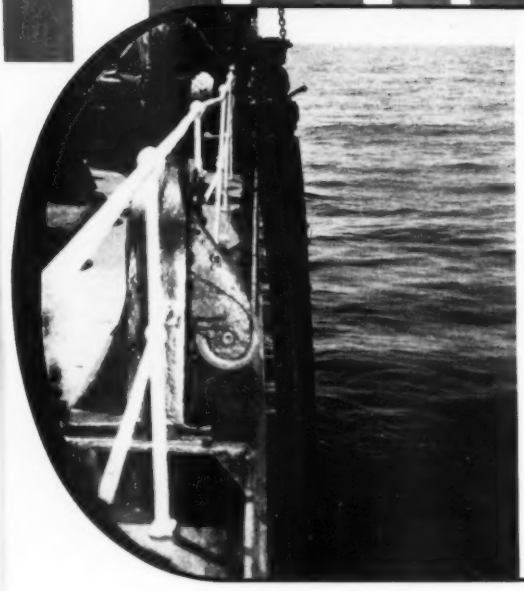

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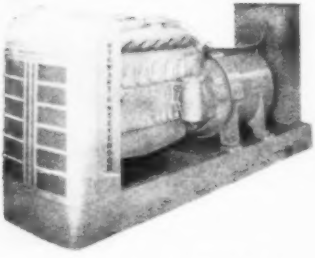

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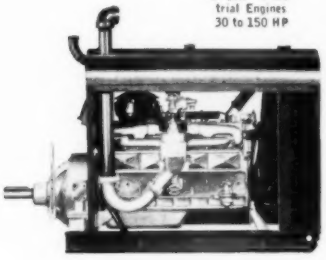

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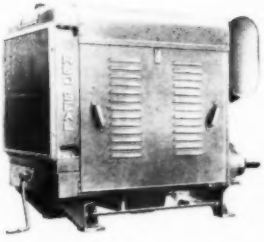

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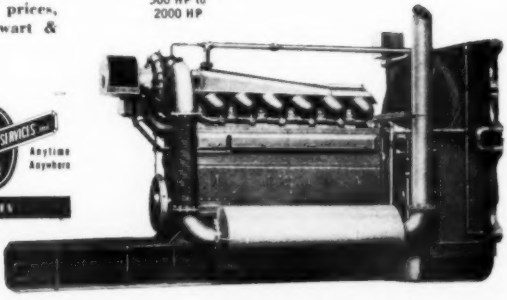

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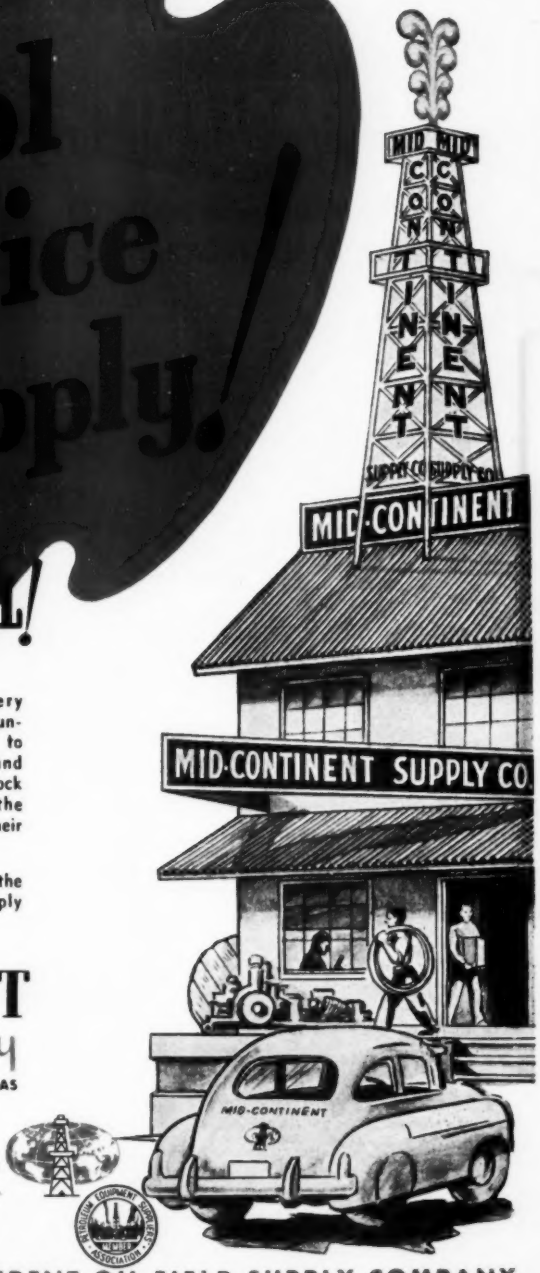

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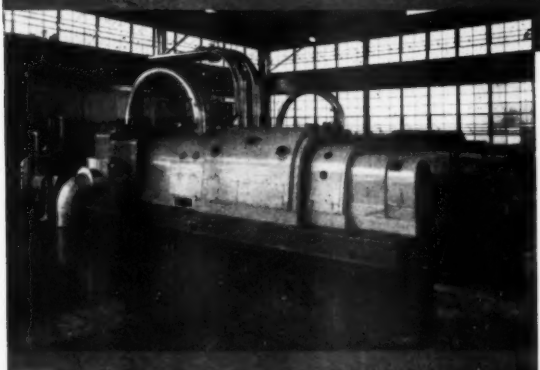

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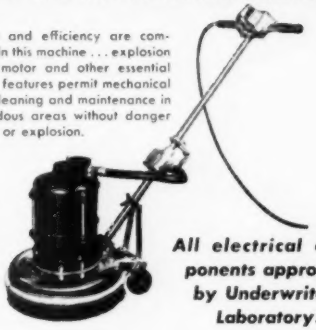

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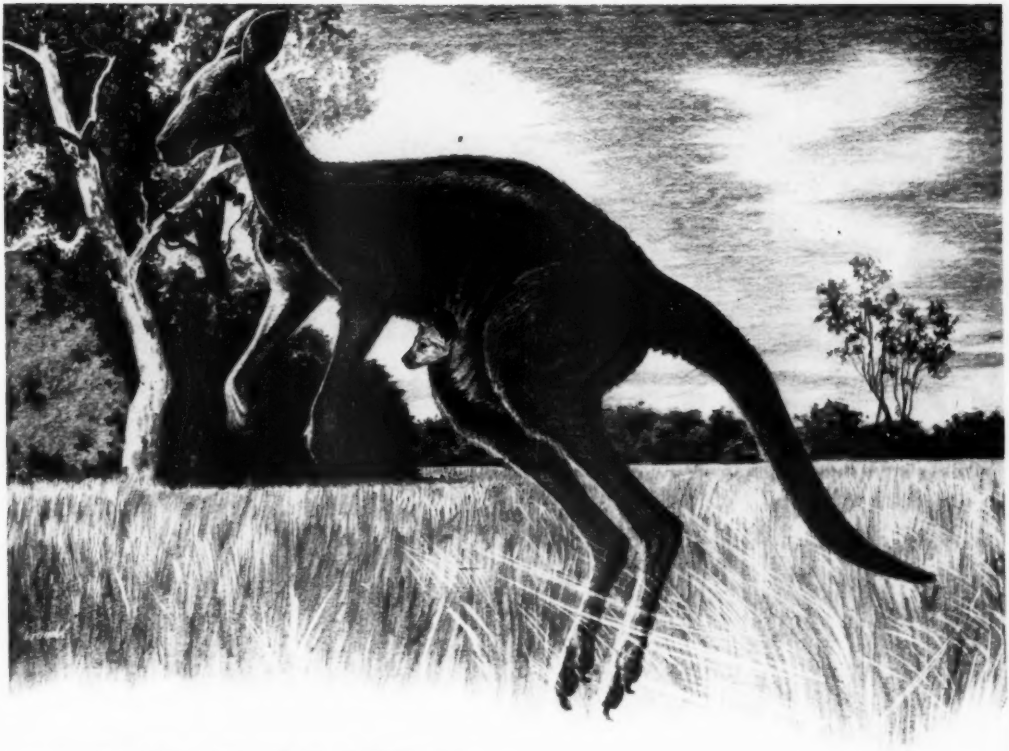

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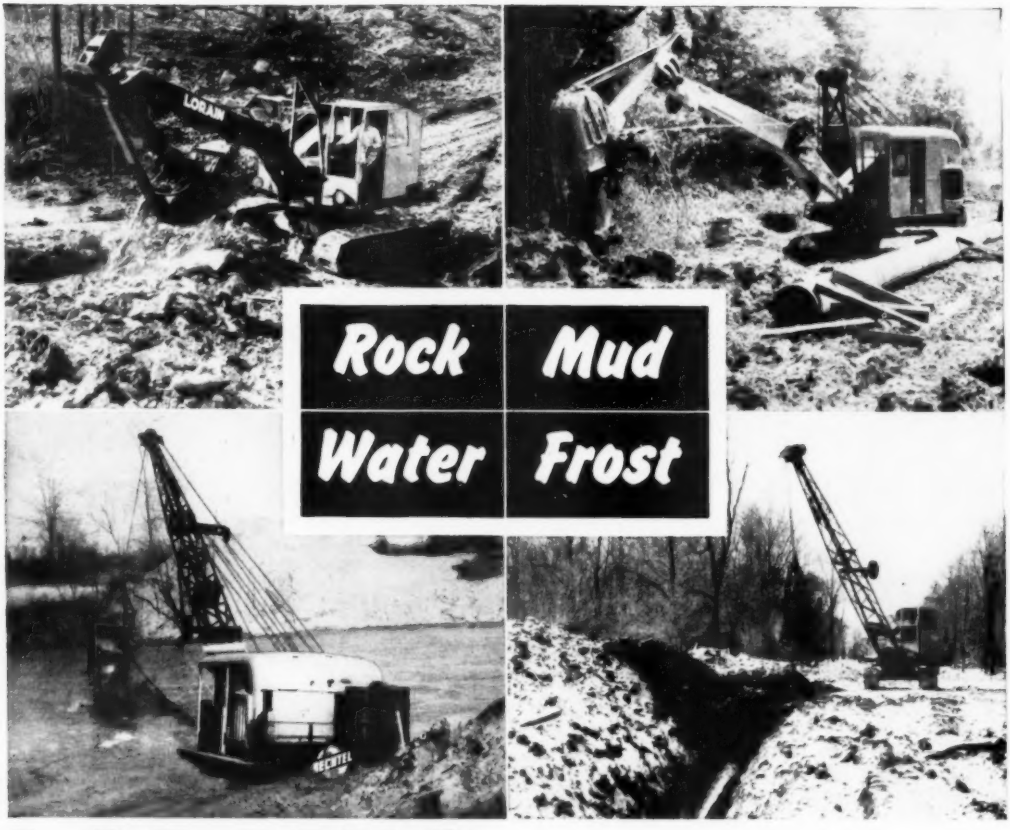

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Bring on the tough ones! Set your cross-country time tables! And let Lorains help you keep those pipeline schedules! Here's proof! Notice the wide range of digging conditions on these four spreads — notice how Lorains choice of crawlers fits each one — standard crawlers for general use with any of 5 interchangeable booms — wide gauge "Pipeliner" crawlers to straddle ditches — extra-long crawlers for soft ground flotation and to prevent "nosing-in" on dragline work.

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Lorains-On-Rubber For High Speed Mobility

Get the complete story, too, about the full line of Lorain Moto-Cranes — rubber-tire machines that can highball at up to 30 m.p.h. between jobs. Thew-Lorain Distributors across the country can furnish full facts.

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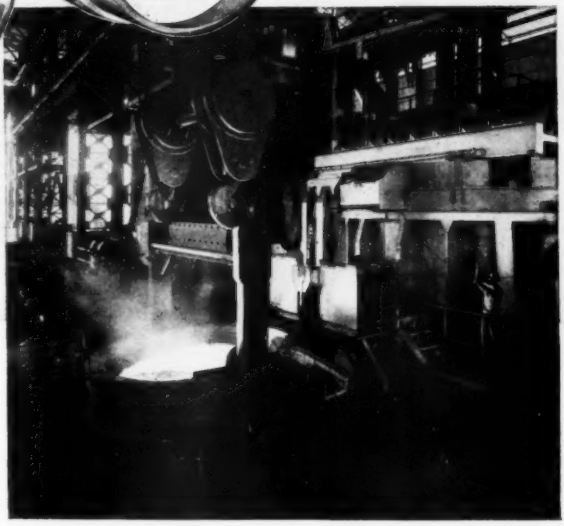
Steel

BULWARK OF FREEDOM, AND...



MORE steel—100 tons more steel every 5 hours. That is what the new electric furnace, pictured at the right, added in August to your at-home steel-making capacity.

Still another of these new, fast steel-making furnaces will be operating at year's end to double this capacity increase. Another blooming mill and auxiliary equipment will also be completed at Sheffield mills.

Yes Sheffield is doing more than its share to enable America to continue to use twice as much steel as all the rest of the world and keep on forging the highest level of better living the world has ever known.

In the past 10 years Sheffield has more than doubled your at-home steel-making capacity. In the same period of time, the steel industry as a whole has increased about one-fourth.

West of the Mississippi and East of the Rockies—Sheffield's primary trade territory—steel-making capacity is looming larger and larger, to meet your needs and make a larger contribution to the industrial growth of the region.

Sleeping Comfort In The Making!

Hard to visualize, isn't it? Sleeping comfort out of a ladle of molten electric furnace steel! But, spring steel is a staple Sheffield product and it puts slumber comfort into thousands of mattresses and boxsprings.

Other Sheffield steel products which serve you perhaps less directly but none the less importantly are—hot rolled bars and angles, plates, sheets, structural shapes, steel joists, reinforcing bars and wire mesh, wire products, wire rods, fence, nails, tacks, bolt and nut products, grinding media, forgings, railway track spikes, etc.

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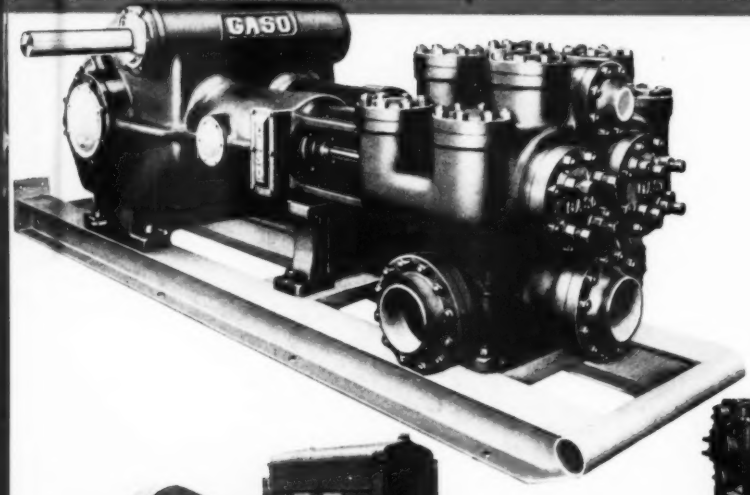
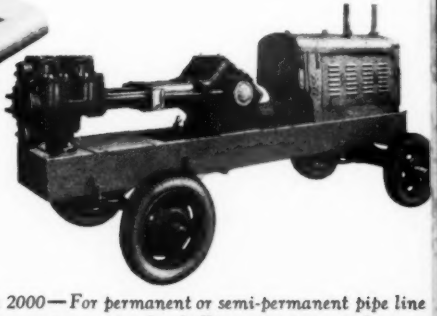
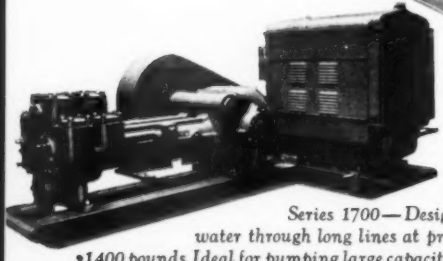
Because They Have Everything



Series 2600—Biggest of Gaso models, created in answer to the demand of producing and pipeline companies for a Gaso-designed pump suitable for large capacity gathering and main line service.





Series 1700—Designed to pump oil or water through long lines at pressures from 260 to 1400 pounds. Ideal for pumping large capacities at high pressures.

Series 2000—For permanent or semi-permanent pipe line stations, water service for drilling operations, pick-up in case of line breaks, mudding or cementing operations.

GASO PUMP & BURNER MFG. CO.

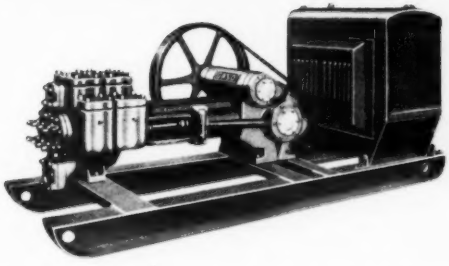
EXPORT OFFICE: 149 BROADWAY, NEW YORK · LOS ANGELES: 2329 CHAMBERS ST., VERNON

PUMPS
industry need

Pipeline Men
Pipeline Men Want . . .

They are available in a complete line of models and sizes, and may be used singly or in series to meet a wide variety of conditions . . . They are easy to install, and easy to move from site to site as required . . . They have an amazing capacity for work, and an equally amazing habit of continuing to work long after ordinary pumps are retired . . . They are made strong to deliver a maximum of trouble-free service, yet backed by a policy of maintaining parts stocks for all standard models ever built, and shipping on the day order is received.

That's why GASO PUMPS have for more than 30 years been the stand-out favorites of pipeline men. May we send you a copy of our latest catalog.



Series 1800—Small 6" stroke pumps equipped for liner sizes from 2½" to 6". Typical uses: Crude oil gathering lines; booster stations; water lines; salt water disposal; slush and acidizing service.

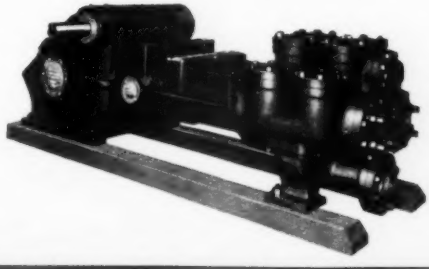


Fig. 1654—Duplex Piston Power Pump for small, heavy-duty slush pump service on portable well drilling rigs, and for high-pressure pipe line service.

902 E. FIRST ST., TULSA, OKLA., U. S. A.

DAVENPORT: W. L. SOMMER CO., 10 LAKE STREET — IN CANADA: LUKE M. MACHINE CO., LTD., EDMONTON, ALBERTA

Here's solid investment

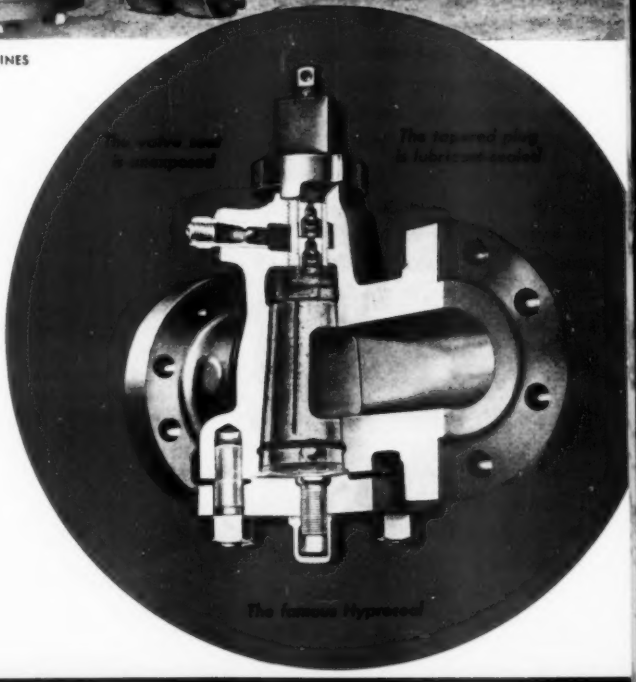
NORDSTROM-EQUIPPED MANIFOLD IN COOLING TOWER LINES

Nordstrom Valves exceed highest safety standards

Uppermost in mind when you invest in valves is *safety*—safety against rupture, safety against leakage, safety in positive operation. You get the fullest measure of safety in Nordstrom lubricated valves. They meet or exceed all Standard Specifications. Their record of unsurpassed performance, exceeding 25 years in innumerable cases, proves their endurance. The fact that practically every leading gas producing, transmission and distribution company has adopted Nordstroms proves acceptance.

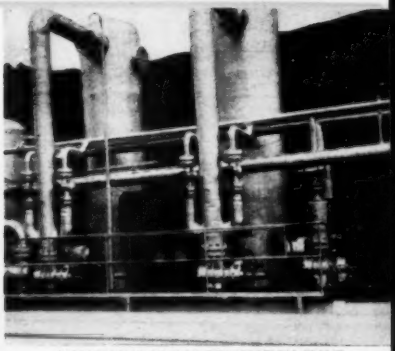
Talk over with your plant and field engineers the desirability of replacing all your troublesome valves with Nordstroms. You'll save money—and increase the safety of your investment.

Write for Pipeline Bulletin V-210.

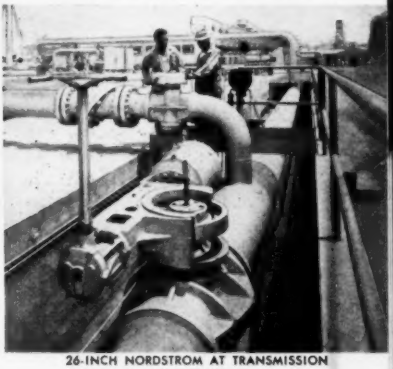


. . . in pipe line safety

A MEASURING STATION IN PENNSYLVANIA, NORDSTROM-EQUIPPED

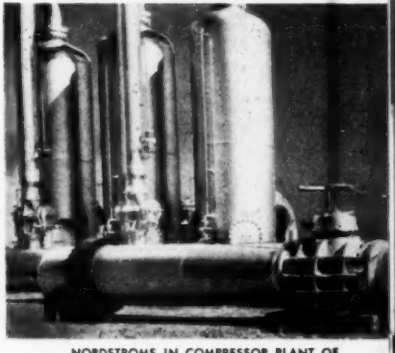


NORDSTROMS IN GAS DEHYDRATION PLANT



26-INCH NORDSTROM AT TRANSMISSION LINE TERMINUS

AUTOMATIC CYLINDER OPERATED VALVES ON GAS TRANSMISSION LINES



NORDSTROMS IN COMPRESSOR PLANT OF CROSS-COUNTRY LINE

KEEP UPKEEP DOWN

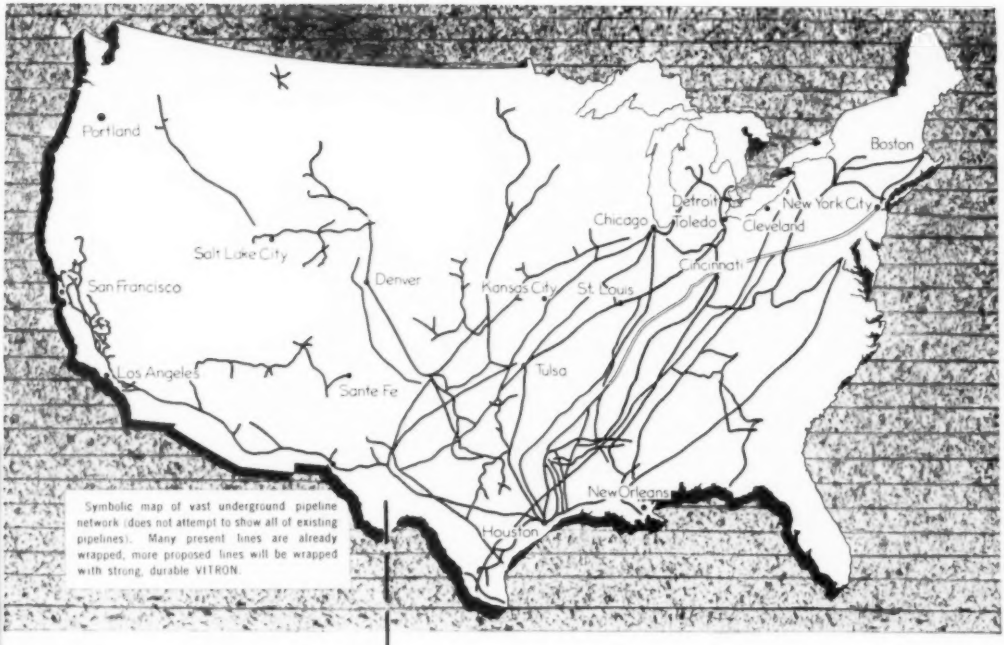
Nordstrom Valves

Synonymous with Dependability

ROCKWELL MANUFACTURING COMPANY

400 North Lexington Avenue, Pittsburgh 8, Pennsylvania

Atlanta, Boston, Chicago, Columbus, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa . . . and leading Supply Houses • Export: Rockwell Manufacturing Co., International Division, 7701 Empire State Building, New York 1, N. Y.



Symbolic map of vast underground pipeline network (does not attempt to show all of existing pipelines). Many present lines are already wrapped; more proposed lines will be wrapped with strong, durable VITRON.

The vital role of Vitron glass fibers in the nation's pipelines

VITRON Underground Pipe Wrap gives longer life to steel pipelines

Right beneath our feet—beneath the broad fields of America—a high speed, mass-volume transportation system is quietly and economically carrying the nation's oil and gas from well to refinery and distribution center. VITRON Underground Pipe Wrap is a vital factor in the long-life expectancy of these history-making steel pipelines.

Applied by high speed coating and wrapping machines, the highly porous VITRON Wrap pulls into the hot coatings, providing strong, durable reinforcement. Coating "bleed through" forms a continuous film, and air and vapor bubbles that can form "holidays" are cut up and reduced by the porous wrap. VITRON-reinforced coatings have greatly increased resistance to impact, soil stresses, moisture and soil acids.

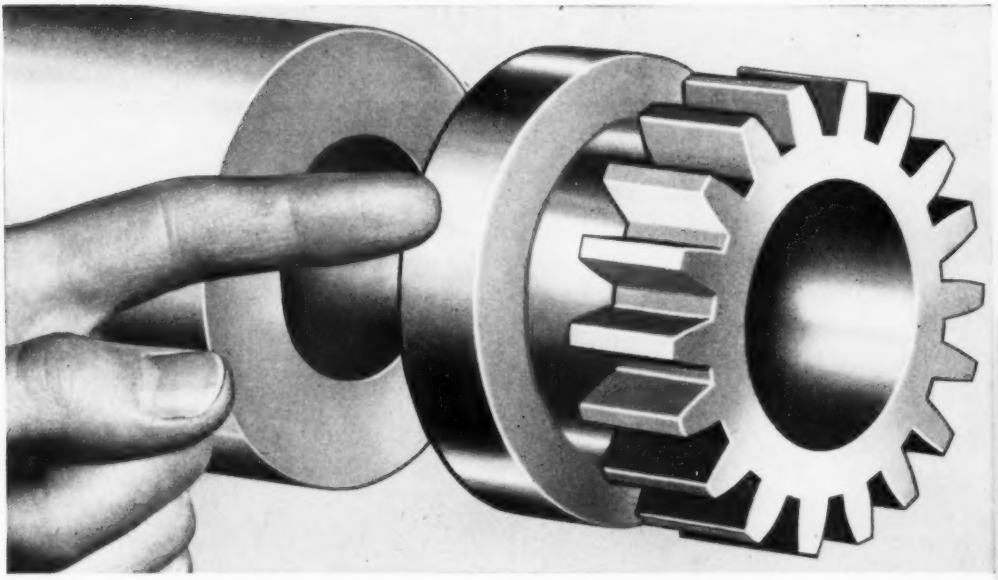
Write for samples and descriptive engineering material.

Vitron®

UNDERGROUND PIPE WRAP

GLASS FIBERS INC. 1810 Madison Avenue • Toledo 2, Ohio

How to get more parts out of a ton of steel!



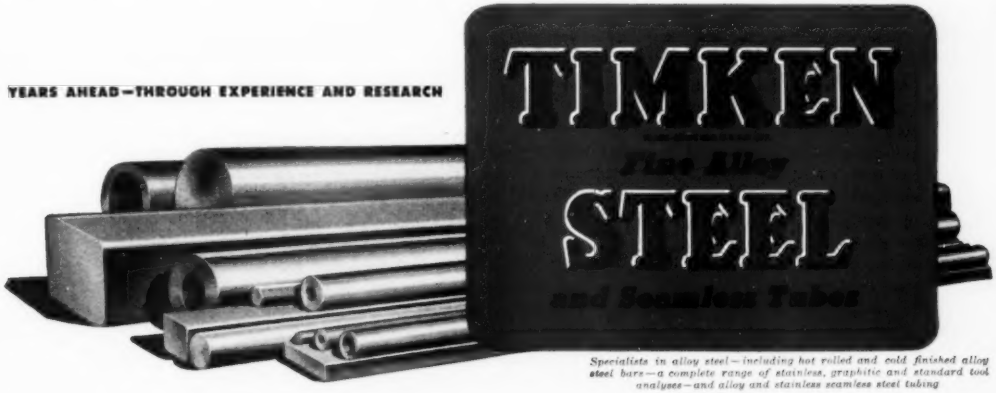
WHEN you use Timken® seamless tubing for your hollow cylindrical parts, the hole is already there. As a result, you machine away less scrap than you do with bar stock—get more parts per ton of steel.

Using tubing also boosts the productivity of your machine tools. Since drilling the center hole is eliminated, finish boring is often your first production step. Screw machine stations are released for other operations. You have more machine capacity without adding more machines.

What about quality of product? Because the piercing process by which Timken tubing is made is basically a forging operation, the tubing has a uniform spiral grain flow for greater strength and a refined grain structure which brings out the best in the quality of the metal. And this fine forged quality is uniform from tube to tube and heat to heat, thanks to the Timken Company's rigid quality control.

As further help in saving steel, the Timken Company offers a tube engineering service which recommends the most economical tube size for your job. And the recommended tubing is *guaranteed* to clean up to your finish dimensions. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

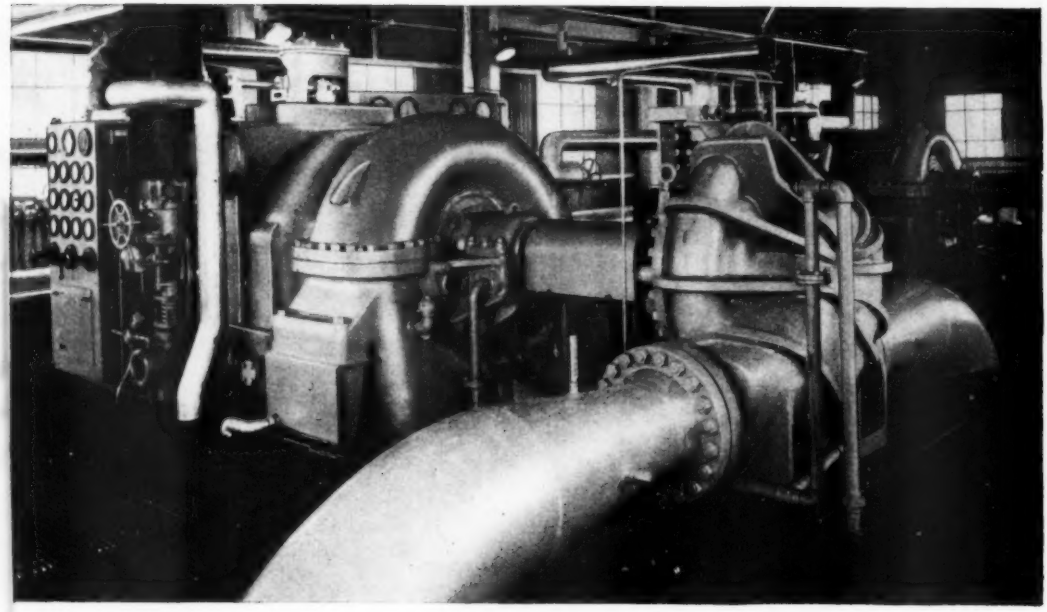
YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH



Specialists in alloy steel—including hot rolled and cold finished alloy steel bars—a complete range of stainless, graphitic and standard tool analyses—and alloy and stainless seamless steel tubing

NEW COMPRESSOR

Now in Operation on



"I-R PACKAGED" steam turbine-driven centrifugals permit important savings in foundation and installation costs

TRANSCONTINENTAL GAS PIPE LINE CORP., Houston, is now pumping gas on its new 1840-mile pipeline from Texas to the Eastern Seaboard. The 30" line extends from the lower Rio Grande Valley to 134th Street, New York City.

At Station Five in Eunice, La., which was designed and built by Fish Engineering Corporation, two Ingersoll-Rand steam turbine-driven centrifugal compressors are already operating while a third unit is on order. These machines represent a new development in gas pipeline compressing. They are completely self-contained "packaged units" consisting of a steam turbine and a centrifugal compressor mounted directly on a surface-type steam condenser.

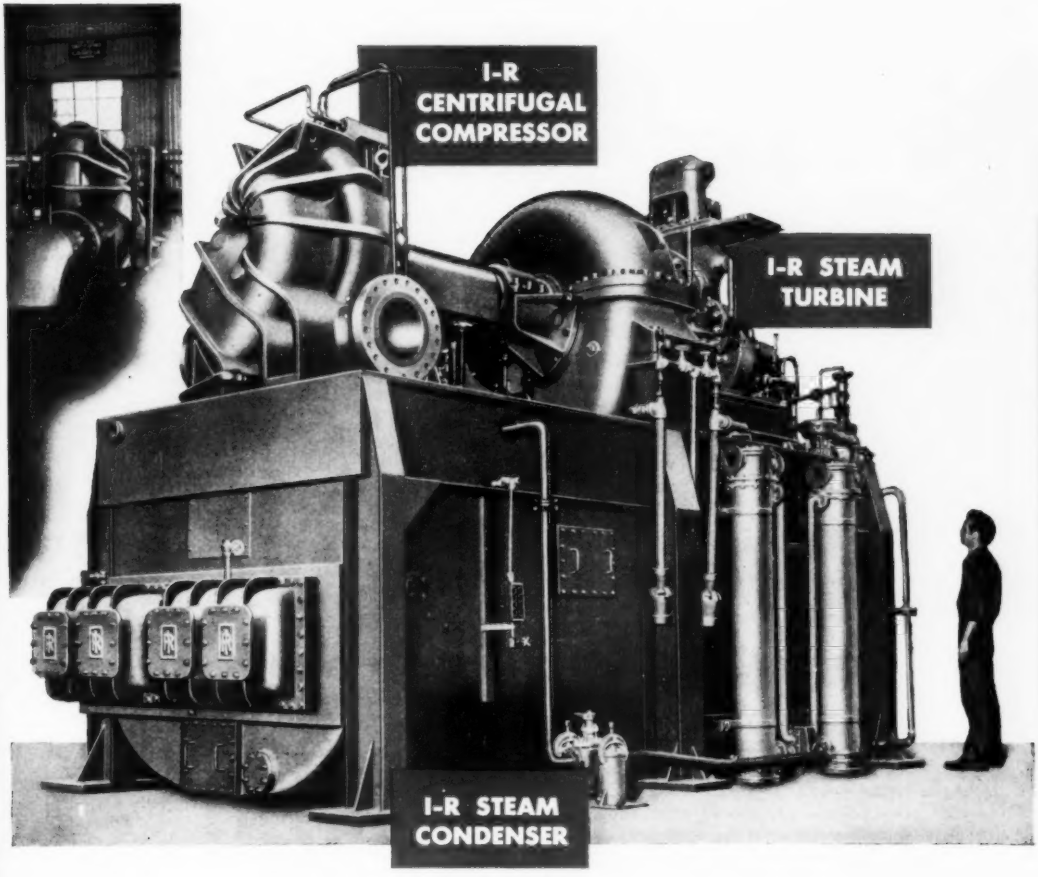
The entire unit, including the condensate pumps and ejectors, was designed and built by Ingersoll-Rand. This packaged construction has permitted substantial savings in foundation costs and in the time and expense required for installation.

The three I-R centrifugals, arranged in series, will handle 465 million cubic feet of gas per day and boost the pressure from station intake of 470 psig to full line pressure of 800 psig. Ingersoll-Rand 4370 hp turbines drive the blowers at 4700 rpm. The Ingersoll-Rand steam condenser, which contains 4600 square feet of condensing surface is designed with special structural steel bracing to provide a foundation for the turbine and blower.

If you have not decided which type of compressor you need—centrifugal or reciprocating—your I-R representative is a good man to have helping you. Ingersoll-Rand has over 80 years of experience in designing and building reciprocating compressors for all types of service. I-R has also been designing and building centrifugal compressors for over 40 years. Call your Ingersoll-Rand representative when you want help and advice.

DEVELOPMENT

Transcontinental's 1840-Mile Pipeline



Designers and Builders of BOTH Reciprocating and Centrifugal Compressors

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

705-12

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO-BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

AEROTEC

DRY SCRUBBER

uses no liquids to scrub natural gas

The phenomenal growth of the natural gas industry has presented problems of cleaning gas both at the well, in transmission, and at distribution points.

Aerotec offers a solution to these problems by the use of small diameter centrifugal tubes removing foreign matter, solids and liquids, leaving the gas dry and clean.

Hundreds of installations prove this method to be a most effective way of scrubbing natural gas. Installations, such as the Texas Eastern Transmission Corporation Station shown above, handle millions of standard cubic feet of gas every day. In the Aerotec Gas Scrubber, the gas is cleaned without using any liquid as a scrubbing medium. Many natural advantages accrue to this method. The use of Aerotec Scrubbing elements in high pressure casings provides a safe, simple method of scrubbing gas.

Why not talk over your problems with our Project Engineers. Their wide experience in the industry will be of inestimable value to you. Write for catalog No. 501.

Canadian Affiliates

T. C. CHOWN, Ltd., 1440 St. Catherine St., W., Montreal 25, Quebec.
50 Abell St., Toronto 3, Ontario

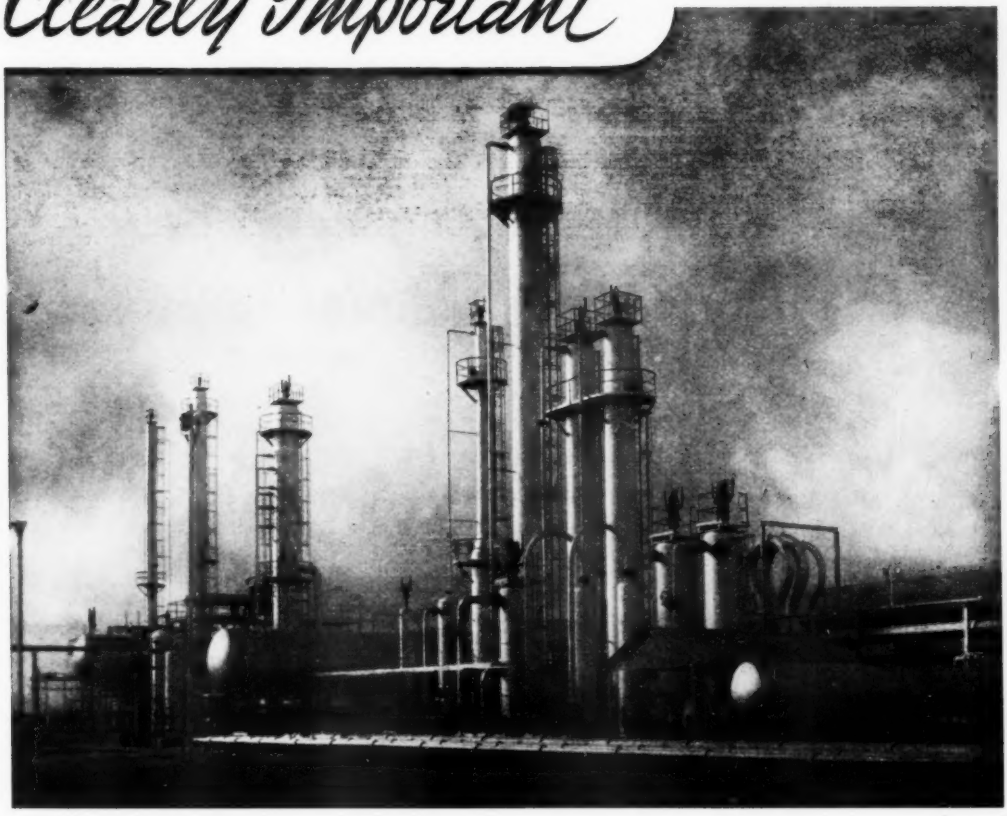
Project Engineers

THE THERMIX CORPORATION
GREENWICH, CONN.

Manufacturers

THE AEROTEC CORPORATION
GREENWICH, CONN.

Clearly Important IN MODERN INDUSTRY



NEWALLS

HEAT, COLD AND SOUND

for All Temperatures from minus 300°F to 2000°F

INSULATION

Newalls 85% Magnesia covers temperatures up to 625°F while Newalls Newtempheit and E.H.T. Newtempheit will withstand 1625°F and 1830°F respectively. For the higher range of temperatures Newalls Insulating bricks provide efficient and economic insulation.

For the insulation of refrigeration plant Newalls Cork slabs and sections have been successfully and extensively used since their introduction in 1902. Further information on Heat, Cold and Sound insulating materials available on request.

NEWALLS INSULATION CO. LTD. HEAD OFFICE **WASHINGTON, CO. DURHAM, ENGLAND**

A MEMBER OF THE TURNER AND NEWALL ORGANISATION

Telephone: Lowfell 76035 (3 lines)

Telegrams: "Newsulate" Washington Station.

for heavy off-the-road, as well as on-the-highway hauling, electric brakes give you precision synchronization for

SAFE STRAIGHT-LINE BRAKING

Back on the rough roads off main highways, out in the fields where oil is found . . . through muck, mud and other murderous terrain . . . Warner Electric Brakes are right in their element.

Day-in, day-out Warner Electric Brakes give you the *trouble-free, safe* braking you must have in off-the-road operations. There's *full clearance* under tractor and trailer . . . nothing exposed to get knocked off or leak.

And with Warner Electric Brakes you get *precision synchronization* . . . instantaneous, *uniform* braking of all wheels on both the tractor and trailer. There is no time-lag in the action! Braking power is applied *instantly* . . . with the speed of electricity . . . you get immediate response, in the exact degree of power desired.

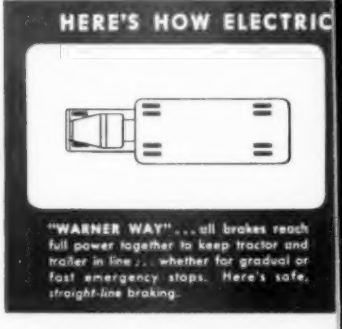
This means smooth, *straight-line* deceleration and stops. Tractor and trailer act as a single unit to guard against skidding, diving, sliding, jackknifing and bring you a new high in braking safety.

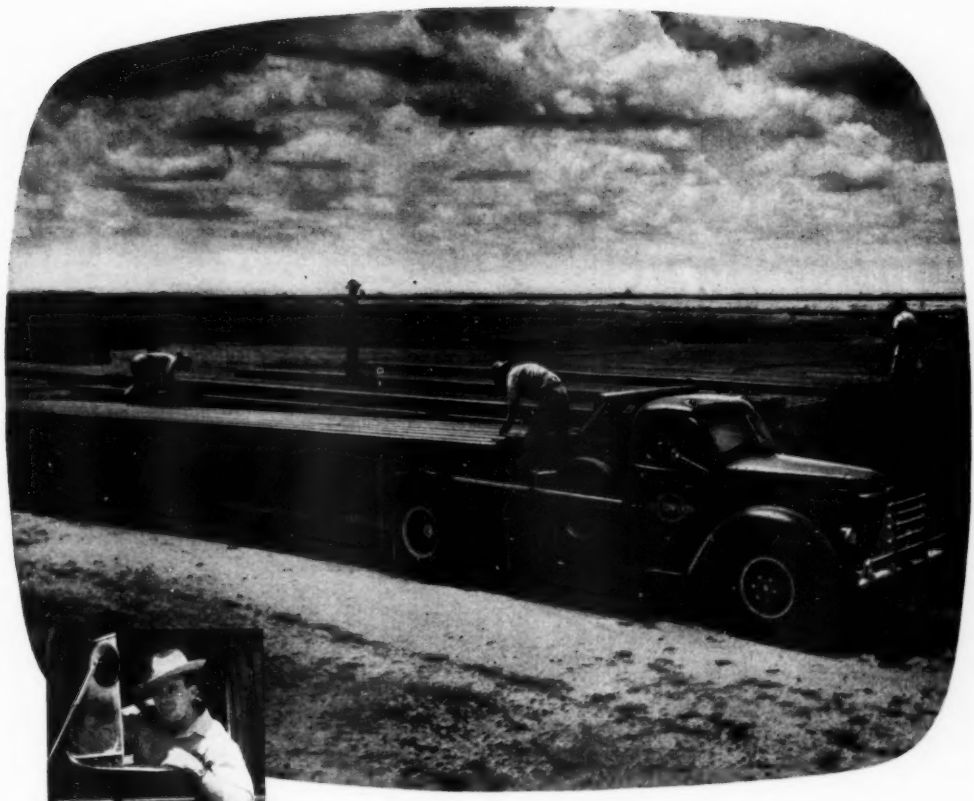
WARNER ELECTRIC BRAKE & CLUTCH COMPANY, BELOIT, WISCONSIN

WARNER

ELECTRIC BRAKES

FOR TRUCK TRAILERS


HERE'S HOW ELECTRIC
"WARNER WAY" . . . all brakes reach full power together to keep tractor and trailer in line . . . whether for gradual or fast emergency stops. Here's safe, straight-line braking.



Precision performance and economy of Warner Electric Brakes proved through years of service on Jess Edwards, Inc. trailers.

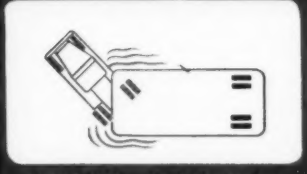
"Our job is to service the oil companies and drilling contractors who have heavy hauling to do.

"Therefore, our operations are off the highway as well as on the highway, moving rigs, pipe and other material pertaining to their operation," reports Jess Edwards, Inc., Corpus Christi, Texas.

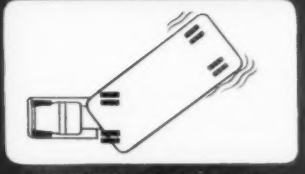
"We have approximately 20 trailers equipped with Electric Brakes and have found them to be very economical in our line of business. The trailers that our Electric Brakes are on weigh between 3,000 and 7,000 pounds and carry a load from 20,000 to 25,000 pounds.

"Most of our Electric Brakes have been in operation since the early days of the business and have been found to be very satisfactory."

BRAKES PROTECT AGAINST JACK-KNIFING



WRONG WAY . . . here's what can happen when brakes aren't synchronized and tractor brakes "come in" ahead. Jack-knife is sudden, drive wheels slide sharply. Recovery is difficult.



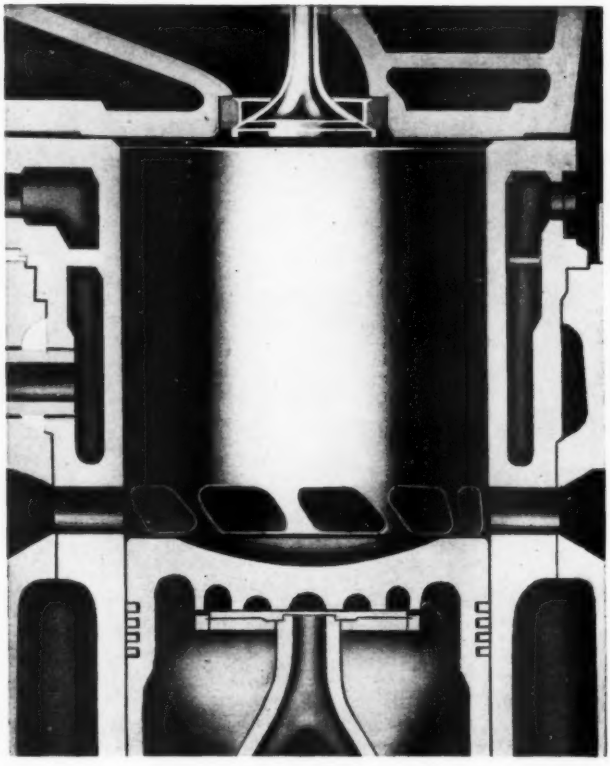
WRONG WAY . . . the other type of trouble that can result when brakes are not synchronized. Trailer brakes "build up" first . . . rear of trailer swings, then comes around into a jack-knife.

FREE! **New factual folder "Six Steps to Better Braking for Truck Trailers." Get your copy now.**

Gives important tips on driver safety through synchronized braking. Explains the precise operation, simplicity of hook-up, amazing economy and added safety features of *electric* braking. Write today. Warner Electric Brake & Clutch Company, Dept. OGJ, Beloit, Wisconsin.

IT'S THE

Biggest News in Gas-Engine Compressors



The *vital* *power center*

that cuts down-time and increases efficiency in many gas and petroleum-processing services

For the first time, a vastly superior type of scavenging has been applied to compressor engines.

Worthington's timed scavenging system, built into the uniflo UTC-16, gives advantages far beyond any previous method.

A Thoroughgoing "Clean Sweep"

Here are some of the features of this new system concentrated in the "vital power center" illustrated above:

Complete removal of exhaust gas . . . more thorough charging with gas and air . . . positive timing for optimum combustion . . . effective supercharging . . . low operating temperature preventing carbonization . . . uniform cylinder temperature resulting in equal wall stress eliminating harmful stresses.

Many Uses . . . Many Sizes

While designed primarily as a pipeline gas-engine compressor, the UTC-16 is suitable for many other services, including: pressure maintenance on oil wells . . . in natural gasoline plants . . . in oil refineries, for solvent extraction, vapor recovery, recycling and stabilization of gases . . . in petrochemical processing of products made from natural gas under pressure . . . in many refrigeration applications.

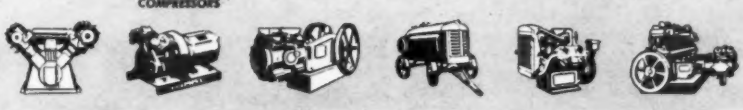
The Uniflo UTC-16 is built in sizes ranging from 800 to 2000 hp. For further proof that *there's more worth in Worthington*, contact our nearest Branch Office, or write the Worthington Pump and Machinery Corporation, Engine Division, Buffalo, N. Y.

WORTHINGTON

ENGINE COMPRESSORS

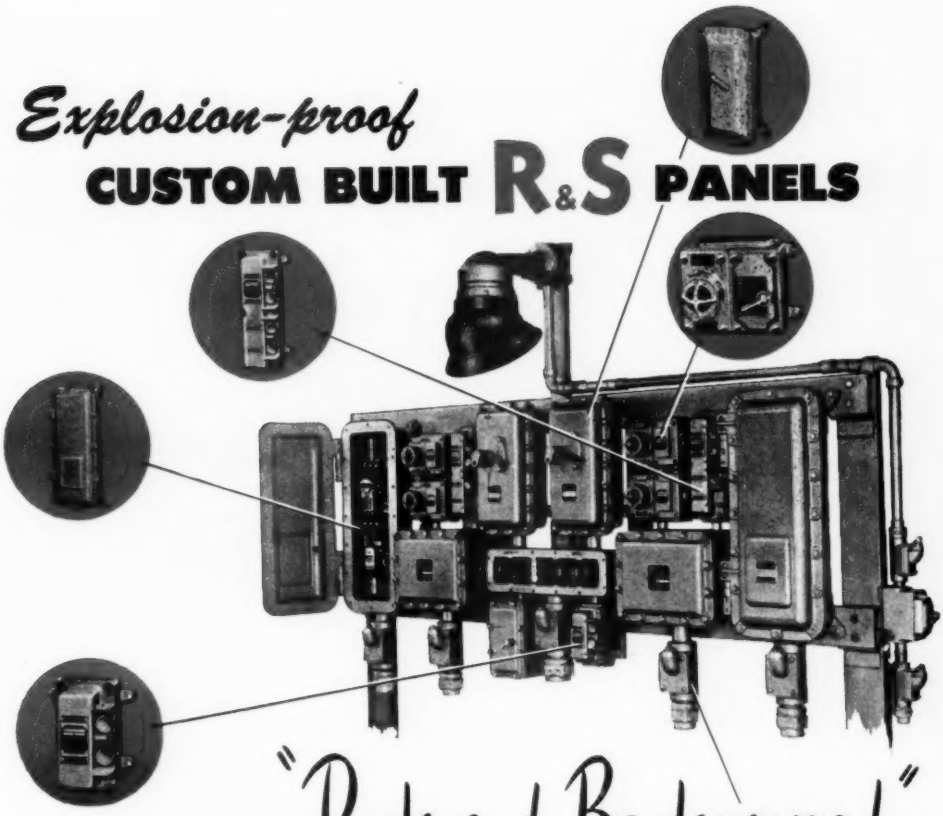
EK.1.2

NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON



Explosion-proof

CUSTOM BUILT R&S PANELS



HAVE A "Packaged Background"

Russell & Stoll custom built panels utilize standard R & S equipment as "packaged" components wherever possible. Note how well this better, faster, more economical construction method has been employed on the oil pipe line plant panel illustrated.

R & S thereby by-passes all the uncertainties, delays and expense of "special design" equipment. R & S panels are factory built, sealed and tested, offering simplified construction and pre-engineered performance.

No panel can be better than any of its component parts. And every R & S panel has benefits that stem from selection and use of precision-made units from the complete R & S explosion-proof line. R & S circuit breakers, switches, pilot lights, push button stations and other control devices have standout advantages such as removable front covers, abundant wiring space and conduit openings — in addition to individual features that meet all standards, *plus*.

WRITE FOR CATALOG NO. H47-13.

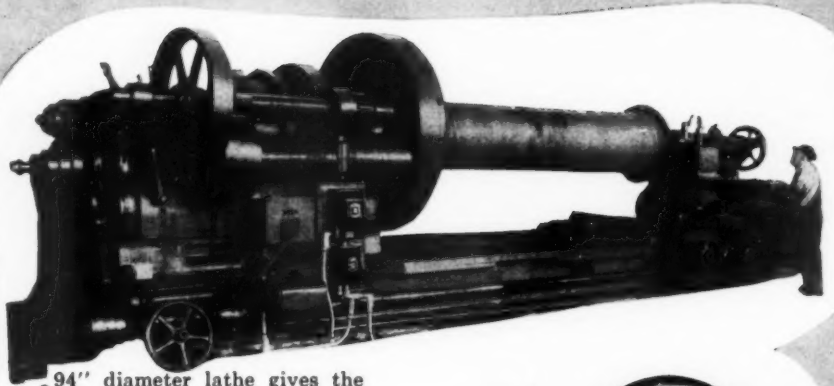
RUSSELL & STOLL COMPANY, INC. • 125 BARCLAY STREET, NEW YORK 7, N. Y.

DS

RUSSELL & STOLL

PRECISION-BUILT ELECTRICAL EQUIPMENT—SINCE 1902

for Your Share of that Extra
75,000 BBLS. PER DAY



● 94" diameter lathe gives the Posey Iron Works an edge on large jobs requiring lathework

Crude-oil input capacity of United States refineries is currently scheduled for an increase of 75,000 barrels per day. That means expansion of storage facilities to keep pace with production equipment now being installed.

For decades, Posey Iron has served the refinery industry with storage equipment especially designed to meet the requirements of the petroleum and L-P gas fields. Posey Iron engineering is based on a *practical* knowledge of the industry . . . the sort of "shirt-sleeves" knowledge that eliminates needless tardiness in delivery . . . needless increase in cost. Consult Posey about your storage requirements.

● View shows bottom of recently erected 200,000 gallon Posey Iron Elevated Tank.

PRESSURE VESSELS — FRACTIONATING TOWERS
ELEVATED TANKS — STORAGE TANKS
LARGE DIAMETER FABRICATED PIPING
GENERAL STEEL PLATE CONSTRUCTION

POSEY IRON WORKS, INC.

Steel Plate Division • Lancaster, Pa.

New York Office: Graybar Building

DIVISIONS: BRICK MACHINERY . . . INDUSTRIAL HEATING . . . IROQUOIS . . . SHIPBUILDING . . . STEEL PLATE.

They Say—

Nationalization Is Goal

"Nationalization of the oil and gas industry is the goal of our busy little bureaucrats in Washington.

"You see their fine hand in the promulgation of . . . theories . . . which would simply establish a dictatorship over fuel production in this country.

"You find them whispering in the ears of uninformed congressmen that the Interstate Oil Compact is a conspiracy between states and the oil companies to violate the antitrust act.

"The tidelands decisions and the administrative policies reflected therein are glaring examples of a trend toward a type of statism that is repugnant to any citizen who believes in the states' assuming their proper responsibilities and retaining their due rights.

"The Interstate Oil Compact provides another answer to the advocates of federal control. It represents the cooperative American way of getting the job done, with each participating unit maintaining its integrity.

"This is the theory and principle of 'states' rights,' translated into effective action."

Gov. Allan Shivers of Texas, before the American Bar Association, New York City.

Competition All-Important

"Is competition a really important factor in the oil industry?

"You don't need to ask an oil man to answer that question. Secretary of the Interior Oscar Chapman provided an excellent response to the query when he said:

" 'Competition is the basic reason for the productive vigor of the oil industry. Accordingly, competition should be retained or disturbed as little as possible . . . . It shall be my purpose, as Petroleum Administrator, to use the power entrusted to me, as far as humanly possible in such a was as to leave at the end of this emergency the same competitive relationships among the units of the oil and gas industry as exist today.'

"The record of oil during and since World War II fully substantiates this view. It is estimated that 22,000,000,000 gal. of oil were needed to conquer Germany alone. The Army and Navy Petroleum Board is authority for the statement that, 'not one single military operation was delayed or impeded because of lack of petroleum products.' The competitive American oil industry supplied that vast flood to the fighting forces and, in addition, met every essential civilian need.

"And today, the industry is able

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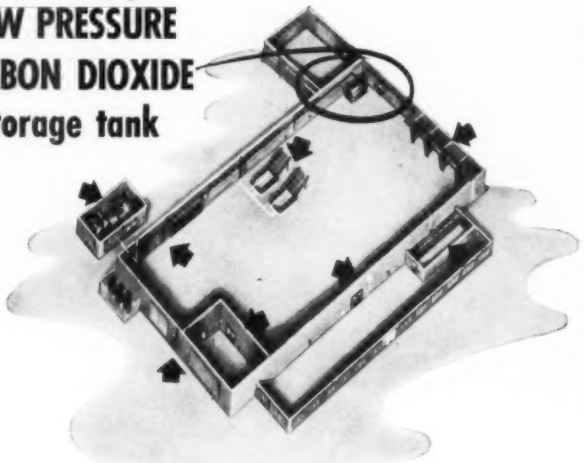

Now, your larger size fire hazards can be protected more efficiently at less cost, thanks to C-O-TWO Low Pressure Carbon Dioxide Type Fire Extinguishing Systems. Simple piping, running from one centrally located storage tank, instantly transports clean, non-damaging, non-conducting carbon dioxide anywhere in the plant area . . . to flammable liquids, electrical equipment, storage spaces, manufacturing processes and record vaults. Fire at any protected location is extinguished in seconds with an absolute minimum of expense and interruption.

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to produce and market 25 per cent more oil and oil products than it did at the peak of World War II.

"Quantity isn't the whole story. As a result of the competitive struggles between oil companies in their search for consumer favor, the quality of oil products has been greatly improved. To take one example, 2 gal. of 1951 gasoline will do the work of 3 gal. of 1926 gasoline. And the price, excluding the taxes over which the industry has no control, is about the same.

"Free competition gives the nation both more production and higher grade products. Oil is a first class example of that truism."

Editorial in The Oil City (Pa.) Derrick.

"Work Through the People"

"Congress has debated the depletion allowance pro and con many, many times and the House of Representatives this year has again voted to uphold it. Yet this incentive is the target for constant sniping attacks by Washington bureaucrats.

"If the bureaucrats could have their way, would we be better off—would we have more oil products? The answer is clearly no—when you check results in Mexico, Russia, South America, the Near East. When Government has tried to run the show the tent has collapsed. There is no reason to believe the results would be any different here.

"Let's make no mistake about it; Government is sitting across the table from us when we take any action toward planning for tomorrow's market.

"If Government is to continue to be our partner then we must do our best to make a better partner of Government. The way to do that is to work through the people. If the politicians will listen only to the voice of the voters, then it is our job to show the people that it is in their best interest to make a good partner of Government.

"Nobody will argue against better government; people simply argue about which kind would be better. The kind we want and the kind the people want is the kind that has made this country the best place in the world to live."

R. F. Baity, Chicago, vice president of sales, Standard Oil Co. (Ind.) before the Oil Men's Club of Kansas City, Mo.

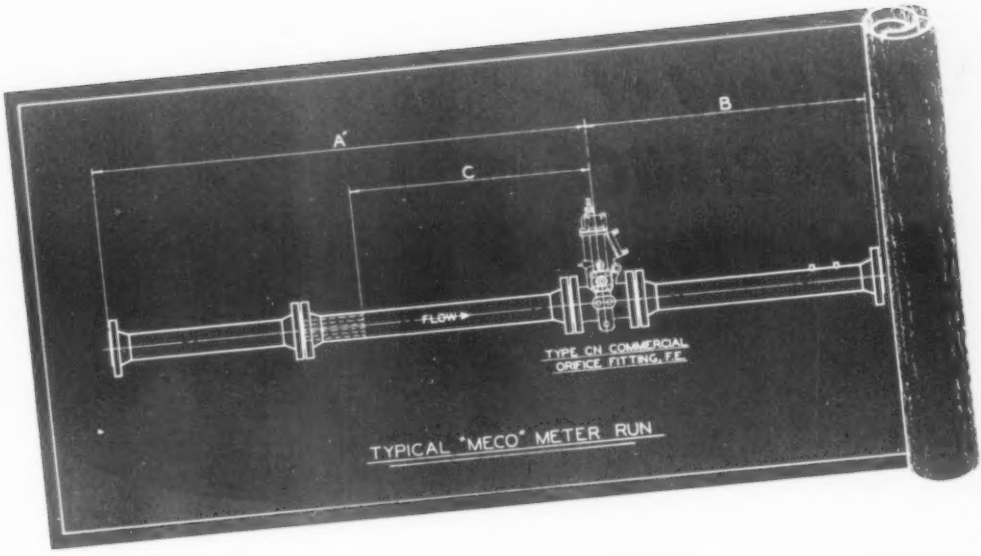
CALENDAR

October

American Institute of Mining and Metallurgical Engineers, petroleum branch, fall meeting, Oklahoma City, October 3-5.

California Natural Gasoline Association, twenty-sixth annual fall meeting, Ambassador Hotel, Los Angeles, October 4-5.

Texas Mid-Continent Oil and Gas Association, annual meeting, Hotel Beaumont, Beaumont, Tex., October 8-9.



American Gas Association specifications require that the I.D. of upstream meter tube and flowbore of orifice fittings match within ¼ *of 1%*.

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J. C. BRISCOE, Vice President

J. C. MINYARD, General Superintendent

American Oil Chemists' Society, fall meeting, Edgewater Beach Hotel, Chicago, October 8-10.

National Safety Council, thirty-ninth national safety congress and exposition, Stevens Hotel, Chicago, October 8-12.

Indiana Independent Petroleum Association, fall convention, Hotel Severin, Indianapolis, October 13-14.

Oil Progress Week, October 14-20.

National Association of Corrosion Engineers, Permian Basin Corrosion Tour, Odessa, Tex., October 15-16.

American Petroleum Credit Association, twenty-seventh annual conference, Adolphus Hotel, Dallas, October 15-17.

American Gas Association, annual convention, Kiel Auditorium, St. Louis, October 15-17.

National Metal Congress and Exposition, American Society for Metals, American Welding Society, American Institute of Mining and Metallurgical Engineers, and Society for Non-Destructive Testing, Hotels Statler, Book-Cadillac, and Detroit-Leland, Detroit, October 15-19.

Institute of Gas Technology, annual meeting, Chicago, October 18.

American Chemical Society and Southern Association of Science and Industry, Southwide Chemical Conference, Wilson Dam, Ala., October 18-20.

National Association of Corrosion Engineers, South Central Region, annual meeting, Corpus Christi, Tex., October 18-20.

American Association of Petroleum Geologists, regional meeting, Commodore Perry Hotel, Austin, Tex., October 18-20.

Natural Gasoline Association of America, southern regional meeting, Blackstone Hotel, Tyler, Tex., October 19.

American Institute of Chemical Engineers, sixth annual South Texas Section technical meeting, Hotel Galvez, Galveston, October 19.

Independent Petroleum Association of America, Shamrock Hotel, Houston, October 22-23.

American Institute of Electrical Engineers fall general meeting, Hotel Cleveland, Cleveland, October 22-26.

Fifteenth Penn State Technical Conference on Petroleum Production meeting at State College, Pa., October 24-26.

Society of Exploration Geophysicists, eastern regional meeting, Webster Hall Hotel, Pittsburgh, October 25.

American Institute of Mining and Metallurgical Engineers, petroleum branch, annual meeting of West Coast chapter, Elks Club, Los Angeles, October 25-26.

Society of Automotive Engineers, diesel engine division, Drake Hotel, Chicago, October 29-30.

American Institute of Mining and Metallurgical Engineers, fall meeting of all branches in connection with Mexican Bureau of Mines, Hotel Del Prado, Mexico City, October 29-November 3.

American Society for Testing Materials, northern California district, San Francisco, October 31.

Society of Automotive Engineers, fuels and lubricants division, Drake Hotel, Chicago, October 31-November 1.

November

Louisiana-Arkansas Division, Mid-Continent Oil and Gas Association, twenty-ninth annual meeting, Roosevelt Hotel, New Orleans, November 1-2.

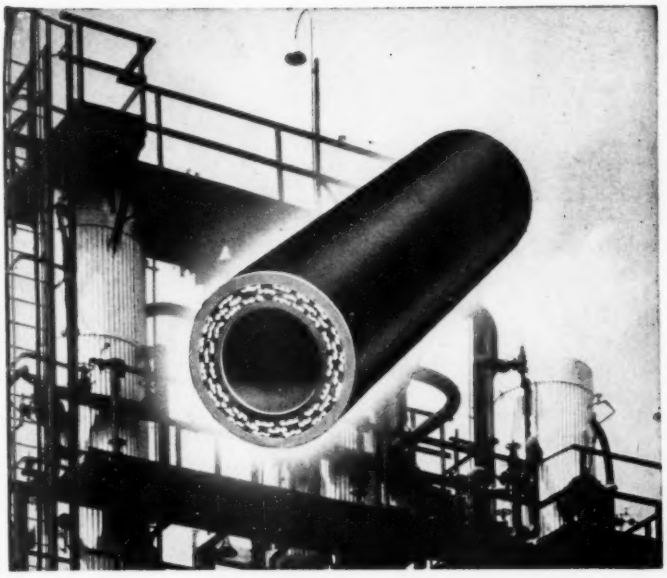
American Association of Petroleum Geologists, Society of Exploration Geophysicists, and Society of Economic Paleontologists and Mineralogists, annual joint meeting, Pacific sections, Ambassador Hotel, Los Angeles, November 1-2.

American Petroleum Institute, thirty-first annual meeting, Stevens Hotel and Palmer House, Chicago, November 5-8.

Southwest Research Institute, second conference on coastal engineering, Rice Hotel, Houston, November 7-10.

American Society for Testing Materials, southern California district, Los Angeles, November 8.

Gulf Coast Association of Geological Societies, first annual meeting, Roosevelt Hotel, New Orleans, November 15-17.



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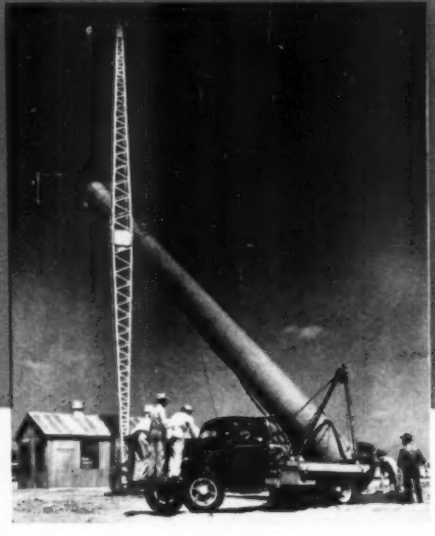

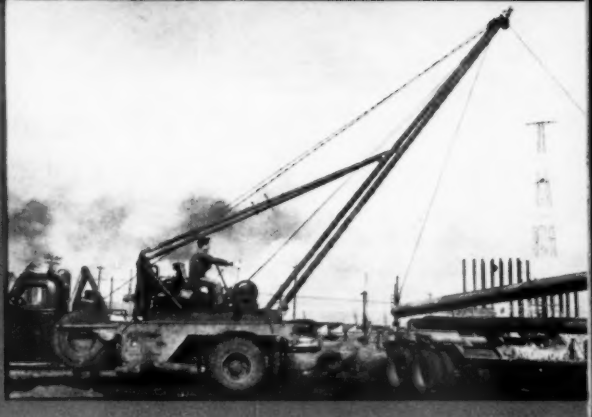

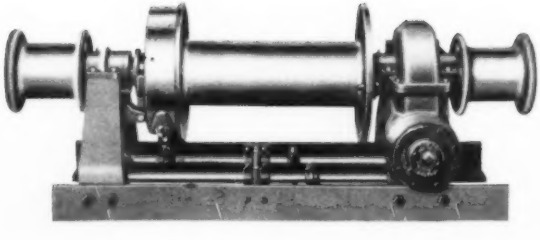

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Rocky Mountain Oil and Gas Association annual meeting, Cosmopolitan Hotel, Denver, November 15-17.

Society of Exploration Geophysicists, regional meeting, Baker Hotel, Dallas, November 19-20.

Natural Gasoline Association of America, Panhandle-Plains regional meeting, Herring Hotel, Amarillo, Tex., November 20.

Mid-Continent Oil and Gas Association, annual board of directors meeting, Tulsa Club, Tulsa, November 20.

American Society of Mechanical Engineers, annual meeting, Chalfonte-Haddon Hall, Atlantic City, November 25-30.

Twenty-third Exposition of Chemical Industries, Grand Central Palace, New York City, November 26-December 1.

December

American Institute of Chemical Engineers annual meeting, Chalfonte-Haddon Hall, Atlantic City, December 2-5.

Chemical Specialties Manufacturers Association, thirty-eighth annual meeting, Mayflower Hotel, Washington, D. C., December 3-4

American Association for the Advancement of Science, annual meeting, Philadelphia, December 27-28.

1952 Meetings

Society of Automotive Engineers, annual meeting, Hotel Book-Cadillac, Detroit, January 14-18.

American Association of Petroleum Geologists, Rocky Mountain Section, second annual convention, Salt Lake City, February 28-29.

American Society for Testing Materials, spring meeting, Hotel Statler, Cleveland, March 3-7.

National Association of Corrosion Engineers, eighth annual conference and exhibition, Galvez Hotel, Galveston, Tex., March 10-14.

American Institute of Chemical Engineers, regional meeting, Atlanta, March 16-19.

American Petroleum Institute, Division of Production, Mid-Continent district meeting, Broadview Hotel, Wichita, Kans., March 19-21.

Southwestern Gas Measurement Short Course, University of Oklahoma, Norman, April 8-10.

Southern Gas Association, annual convention, Galveston, Tex., April 28-30.

American Institute of Chemical Engineers, regional meeting, French Lick, Ind., May 11-14.

American Gas Association, Natural Gas Department spring meeting, Biltmore Hotel, Los Angeles, May 12-13.

American Petroleum Institute, Division of Refining, seventeenth midyear meeting, San Francisco, May 12-15.

American Gas Association, production and chemical conference, Hotel New Yorker, New York, May 26-28.

Canadian Gas Association, Chateau Frontenac, Quebec, June 8-12.

American Petroleum Institute, midyear standardization meeting, Brown Palace Hotel, Denver, June 9-14.

American Society for Testing Materials, annual meeting, Hotel Statler, New York, June 23-27.

NOMADS

Tulsa Nomads, third Friday of each month. After Five Room, Tulsa Hotel.

Dallas - Fort Worth Nomads, first Monday of each month, Greater Dallas Club.

Houston Nomads, second Monday of each month, Ye Olde College Inn, Houston.

Los Angeles Nomads, second Wednesday of each month, Jonathan Club.

New York Nomads: October 29, regular meetings, Louis Sherry's; December 8, Christmas dinner dance, Hotel Pierre.

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JOURNALLY Speaking

The Brain

COUPLA weeks ago our favorite oil publication had a yarn on how Magnolia Petroleum Co.'s "electronic brain" solves all kinds of oil problems and predicting that the field of its usefulness is still largely unexplored.

Now comes a press release from the National Geographic Society which says that it's old stuff. Man's 10 fingers were the first adding machine, it says, which accounts for the decimal system. But since these electronic marvels don't have fingers to count on they use the binary system in which there are only two digits, 0 and 1. Under this system, 2 is written 10, 3 is 11, 4 is 100, and the date 1951 is written 11110011111. (This is too deep for us, so if you don't mind we'll hang on to the decimal system so we can continue to count on our fingers.)

Long before the Christian era, men were using calculating machines called abacus. (You know what an abacus looks like—it's the first picture in the dictionary after aardvark.) In 1617 a Scotsman built a calculator that would multiply, and in 1800 an English mathematician designed one that could have done anything the electronic marvels of today can do but it was so complicated he died before getting it built.

But after debunking the notion that a mechanical brain is a twentieth-century idea, the N.G.S. agrees with Magnolia that these gadgets have quite a future.

"They make decisions, choose between different courses of action, determine instructions by themselves, and generally 'remember,'" it says. "Thus many scientists say such computers show attributes of 'thinking.'"

"Yet actually they are morons. If a machine were to be built simulating all the nerve connections of the human brain, it has been estimated that it would need a skyscraper to house it, the power of Niagara Falls to run it, and all of Niagara's water to keep it cool.

"Some day such a 'brain' may be built, far faster and more accurate than any human mind. With techniques known, mathematicians predict, the calculating machine will eventually play perfect chess, orchestrate a melody, forecast weather, type letters directly from dictation, or even beat the stock market."

All well and good, but until this mechanical monster can discover oil and write about it, both the editors and the readers of the Big Yellow Book can be reasonably safe from the danger of technological unemployment.

Wildcatter's Dream

FAIN GILLOCK is a wildcatter who dreams. That probably is a redundant statement, because if a man didn't dream he wouldn't be a wildcatter. It was his ability to dream and then to act on his dream that led him to discover a lot of oil in his day, including the rich Gillock field in Galveston County, Texas.

Now Gillock is acting on another dream he has had all his life, a dream of an organization of wildcatters. Ever since the Drake well, he says, wildcatters have explored the unknown and led the expansion of the oil industry but they have never had an organization through which they can promote their acquaintance and work for their mutual benefit.

So Gillock, on his own hook, has started the ball rolling by launching the Wildcatters' Congress and has opened a temporary office in Washington. Eventually, he dreams, the organization may build permanent headquarters and perhaps a rest home for depleted wildcatters on a tract of land in Tennessee he will donate for the purpose.

Gillock's dreams for the Wildcatters' Congress are quite embracing, and include such activities as annual and regional meetings, cooperation with government agencies, educational scholarships, an annual award for achievement in wildcatting, and publication of books, a monthly newsletter, and a quarterly journal. That is all fine, but from personal experience we can warn Gillock and his associates that the publishing part of the project will require not only dreams but a lot of hard work and before they get very far into that activity they may wish they had stuck to wildcatting.

—Henry D. Ralph

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October 4, 1951

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DO YOU KNOW HOW "Metal Petals" BRING YOU SUCCESSFUL CEMENTING RESULTS?

In any cementing where a lower zone must be protected from contamination by the cement slurry (as well as from sloughings or cavings) the Baker METAL PETAL Basket will be found both safe and successful.

The unit is constructed of a number of individual "petals" made of flexible sheet metal. These petals are mounted on reinforcing spring steel ribs, which in turn are mounted on a ring to form the Basket.

When running in the hole, the upward pressure of the fluid tends to close the "petals" thus providing fluid passageway between the Basket and the walls of the hole, without distortion of the Basket. As soon as the casing comes to rest, upward pressure by the fluid is relieved and the petals expand to contact the walls of the hole. Any tendency of fluid to move downward then presses the flexible petals more firmly against the entire circumference of the hole. Solids strained from the fluid tend to build a bridge inside the Basket which is thus converted into a one-way packer of great strength and effectiveness.

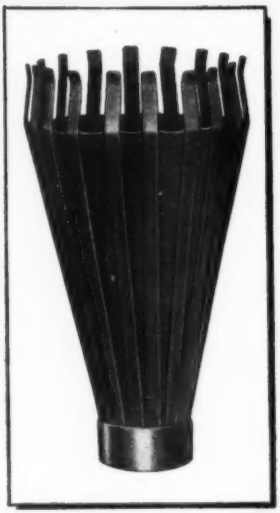
SIMPLE, EFFECTIVE ACTION

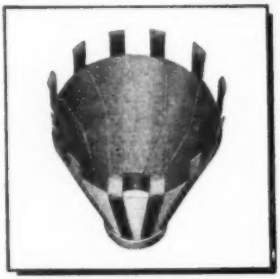
The "Metal Petals" not only expand to contact the entire circumference of large diameter holes, but also pack-off in holes of irregular shape; and the independent action of the individually mounted overlapping petals permits successful use of the Basket in casing programs with minimum clearances.

All-metal construction and design provide ample strength; lessen the possibility of splitting or otherwise damaging the Basket while it is being run in; and the metals are unaffected by usual acids employed for various purposes.

MOUNTINGS TO MEET ALL NEEDS

Baker Metal Petal Baskets are furnished mounted on plain or perforated nipples; with or without different types of Baker Whirler Float Collars; for a wide range of cementing applications. When conditions permit, it is recommended that Baker Metal Petal Baskets be "slidably" mounted to allow rotation, spudding, or reciprocation of the casing without distorting or damaging the Basket. Maximum efficiency of Baskets is assured when a Baker Model "G" Casing Centralizer is used immediately below the Basket assembly. For details see the Baker (or Composite) Catalog; or ask any Baker representative for specific recommendations.





TOP, Baker Metal Petal Basket (Product No. 340) ready for assembly into any required cementing hook-up. The strong, spring steel ribs, each with a "metal petal" attached, expand against the wall of the hole to form a safe "one-way" packer which prevents downward movement of the cement slurry.

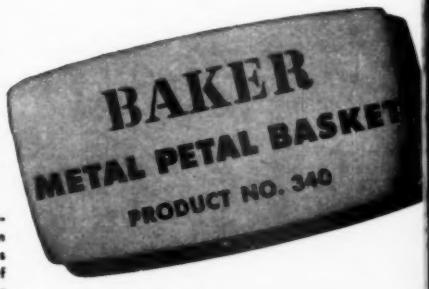
LOWER VIEW illustrates the overlapping "petals" (each mounted on its individual spring steel rib) thus providing flexibility and freedom of expansion to pack-off around the circumference of large-diameter holes, or holes of irregular contours. A Baker Model "G" Casing Centralizer mounted just below the Basket is recommended.

LEFT, a popular hook-up consisting of a Baker Metal Petal Basket mounted on nipple, with a Baker Cement Whirler Float Collar with Solid Baffle (Product No. 305) which causes the cement slurry to pass through the baffled, side-whirler ports.

RIGHT. Where the casing is to be rotated or reciprocated while cementing, the Metal Petal Basket is "slidably" mounted between two Stop Rings. This permits free rotation, and ample vertical movement of the casing, without distorting or damaging the Basket.

HERE'S AN EXAMPLE OF STRENGTH

The Baker Metal Petal Basket holds a record for keeping cement ABOVE and OUT OF a "zone" possessing *lower formation pressure* and *higher permeability* than is likely to be encountered in any oil well. The "zone" was an *open* coal mine stope (lateral) through which a 16-inch hole had been drilled. A Baker Metal Petal Basket, mounted on 10¾" casing (used as the surface string) successfully supported a 640-foot column of cement slurry above the stope, without breakdown or leakage. This example not only demonstrates the bridging ability of the Basket assembly, but also is evidence of the tremendous structural strength which it possesses.



BAKER OIL TOOLS, INC.

HOUSTON • LOS ANGELES • NEW YORK

Pipe-Line Progress

Tremendous progress, both technical and geographic, has been made by the pipe-line industry in recent years, and there appears to be no ceiling on the future. Expanding fuel markets and a competitive industry demand more lines, bigger lines, more efficient lines, and pipe liners always meet the schedule.

This year will go down in pipe-line history as a gas year. The biggest lines, lengthwise, inchwise, and jobwise, have been laid to carry southwest natural gas to regions on both coasts and the Great Lakes clamoring for this cheap and efficient fuel. But now this gas is not so cheap as when those lines were projected, and for other economic and political reasons there may be no new big gas-transmission lines from the Southwest started in 1952.

But there is still plenty of work ahead for pipe liners. The gas industry's growth is by no means halted. It needs gathering lines, distribution lines, intrastate lines, and additions to existing systems, but during 1952 it may have to yield the construction spotlight to oil lines.

The nation's increasing capacity to produce crude oil, barely keeping pace with an insatiable market for petroleum products, demands the early construction of more pipe lines for both crude and products. Several very sizable projects are under way or on the books, and it appears that pipe mills and spread crews will be busy to the limit of steel allocations for as far into the future as anyone cares to forecast.

But pipe-line progress is measured not alone in miles of steel buried. The technological progress has been just as spectacular although perhaps not so visible to the general public. The wartime "Big Inch" of less than a decade ago was news because of its unprecedented diameter, but it proved that big oil lines are practical and economic. The trend in oil lines is definitely toward big-diameter pipe and fewer but larger pump stations because of the development of suitable equipment and economy of operation.

More recent advancements have been made in communication systems for pipe lines, in improved instrumentation, in remote-control installations, and in the art of batching. The station equipment and the techniques and efficiency of operation on a modern pipe line would baffle and amaze a prewar pipe liner.

In spite of the rapid progress, pipe-line engineers are not resting on their laurels. The difficult problem of corrosion, for example, is far from licked, and pipe liners dream of still better weapons. They dream, too, of pipe made of special steel or perhaps some synthetic material which will resist corrosion without coatings, and also of a machine which will join the ends of pipe in the field without tedious hand welding.

Some of these may be pipe dreams, but there is nothing of a smoke-ring character to the technological progress the pipe-line industry has mapped out for itself for the next few years.

THIS WEEK

20,000 MILES UNDER THE GROUND.—Pipe-line construction throughout the world has run about 20,000 miles each of the past 3 years and fully as big a program lies ahead for 1952, according to the Journal survey of construction which is a part of this Annual Pipe-Line Issue.

PIPE LINES—Economic, political obstacles block any immediate plans for big new pipe lines to carry natural gas from Southwest. . . . ¶Trunkline Gas' pipe-line project officially opened, marking completion of Kansas-Michigan gas line a month ahead of schedule. . . .

STEEL—Senate committee may call on officials of defense agencies to explain steel allocations to oil and gas industries in effort to find better way to supply them with critically short tubular goods. . . . ¶Operators in big Spraberry trend of West Texas feeling pinch of tubular-goods scarcity. . . .

INDUSTRY—Problems of hard-rock drilling yielding to research, but much must be done before real progress can be claimed, A.S.M.E. told. . . . ¶New clay cement that seals off porous and cavernous formations described by Magnolia engineers at A.I.M.E. meeting. . . . ¶Novel electric crude warmer keeps paraffin, asphalts in liquid state, increases oil production. . . . ¶Better refining operations made possible by proper use of instrumentation, Tulsa group hears. . . .

PRODUCTION—High crude-oil output, problem of natural-gas flaring slated for discussion at Texas Railroad Commission allowable hearing in Beaumont October 9. . . . ¶Spraberry operators in a quandary on how to best develop vast trend. . . . ¶Humble revamps three oil wells in Texas field for production when area is inundated by new aboveground water reservoir. . . .

WASHINGTON—PAD granted new powers to insure supplies of oil and gas for defense effort. . . . ¶NPA preparing to issue order cutting permissible inventories of sulfur from 90 to 25 days' supply; further reduction around the corner. . . . ¶FPC sticking fast to August 22 decision that Phillips Petroleum Co. does not come under its jurisdiction, denies five applications for rehearing. . . . ¶Wallgren resigns as chairman of FPC. . . . ¶Watts and Webber of PAD resign to return to private business.

ACTIVITY—Crude production averaged 6,229,925 bbl. daily for week ended September 29, up 7,475 bbl. daily from previous week and 389,325 bbl. daily from same date last year. . . . ¶Total completions dropped 13 wells for the week to 907. . . . ¶Wildcat completions were off 23 wells for the week to 198. . . . ¶Rotary rigs operating in United States on September 24 set another record at 2,818, up 35 rigs from previous high on September 10. . . .

TRENDS—Distillate inventories on September 22 amounted to 95,164,000 bbl., a new all-time high which was 2.7 per cent greater than previous record set on November 19, 1949. . . . ¶Changes in stocks by districts from previous record were: District 1, up 3.7 per cent; District 2, up 56.2 per cent; District 3, down 19.0 per cent; District 4, up 6.6 per cent; and District 5, down 41.1 per cent. . . .

INTERNATIONAL—Showdown in Iran nears as Abadan refinery is seized. . . . British appeal to UN to call on Iranians to abide by recommendations of International Court of Justice. . . . ¶Talks resume concerning construction of a refinery in Iraq. . . . ¶New Llandarcy refinery facilities to be ready by mid-1952. . . . ¶Studies being made by U. S. Bureau of Mines to determine feasibility of producing gasoline, chemicals from Irish peat. . . . ¶Airborne-magnetometer survey of Pakistan and India begins. . . .

No Big Gas Lines Soon

Don't look for any new projects to carry gas from the Southwest; too many economic, political obstacles prevail

Henry D. Ralph

NO big new pipe lines to take natural gas from the Southwest to other sections of the country will be built within the next year, and maybe not for a long time.

This was the general view of leaders of the natural-gas industry attending the annual meeting of the Independent Natural Gas Association of America in Oklahoma City last week.

Reasons for this prediction became clear as the gas men discussed the problems facing their industry. There is plenty of gas in the Southwest and plenty of demand for it in the Northeast, Great Lakes, and Pacific Coast states. Steel for a big new line probably could be obtained by allocation from government agencies worried about fuel supplies in industrial areas.

But economic and political obstacles look almost insurmountable at present.

Gas production in Texas, Louisiana, Oklahoma, and neighboring states will increase, but much of it will be consumed right in those states. Existing transmission lines will continue to enlarge their facilities and will purchase and sell more gas. This means expanding markets for gas producers and plenty of work for pipe-line construction crews in laying gathering and distribution lines, intrastate lines, and loops to interstate lines.

Present projects.—At present there are two or three very large construction projects under way to enlarge existing transmission systems, almost comparable in size to some of the new projects built since the war. Here the companies already had gas reserves lined up some time ago and had the financing arranged. Other existing lines plan loopings and extensions to expand sales in present markets and utilize gas reserves dedicated to them but not yet tapped, so there will continue to be some growth in the movement of Southwest gas to other regions.

But no new inter-regional trunk lines like the eight monster projects constructed since the war to move billions of cubic feet of Southwest gas to other parts of the nation.

The chief reasons for this are money and gas. The cost of both is going up.

It takes $100,000,000 or more of initial financing to launch one of these big transmission projects. Interest rates are rising, and the gas men report a growing reluctance in financial centers to tie up funds for 20 years in bonds of a public utility with earnings limited by federal and state regulation.

Dreary outlook.—The outlook for gas is even more dreary. Before the Federal Power Commission will grant a construction permit for an interstate line it must have proof that the promotor has firm commitments from producers to supply enough gas to operate the line at capacity for as many years as it takes to pay off the original investment. This means lining up huge blocks of gas reserves sufficiently close together to make it economical to hook them into the main line.

There are a lot of undedicated gas reserves in the Southwest, but they are mainly of two types: Big blocks held by major oil companies who have little inclination to produce them at present; and smaller blocks of acreage which would be costly to hook together.

"I would hate to go out today and try to put together the reserves to support another big trunk line," said one man who has had considerable experience in that art. "The big holders don't want to sell gas now, and the little fellows don't have enough gas in one place. It would take a lot of gathering lines to connect up enough of these smaller reserves to sustain a big trunk line. And all the producers are looking for higher prices."

Price trend a big worry.—This rising price trend is the biggest worry of the gas-transmission lines. Most of the big lines were planned and financed on gas contracted at 2 to 5 cents per thousand cubic feet at the well head. Even with added transmission costs of around 20 cents per thousand for, say, 1,000 miles, this gas could undersell manufactured gas and most other fuels at the city gates of local distributing systems in industrial areas.

Today the field price for gas is nearer 10 cents on new contracts in all but very remote areas, and some contracts have been made at 12 cents. Some of the older contracts contain escalator clauses which step up the field price every few years, and these are now taking effect.

On the warpath.—There is no doubt about producers being on the warpath for higher gas prices. Years ago gas was largely an unwanted by-product of oil production. A gas well with no oil was apt to be capped and written off as a dry hole, and gas produced with oil was burned on the spot to get rid of it.

Now, with eastern and northern cities clamoring for more natural gas and paying $1 or more per thousand cubic feet at residence meters, the producers think that a field price of 10 cents is little enough. They are out to spike the popular belief in consuming centers that natural gas is a "cheap" fuel.

One barrel of crude oil worth $2.40 at the well has the same heating value as 6,000 cu. ft. of natural gas, which would put a theoretical value of 40 cents on a thousand cubic feet of gas at the well head. This may be unrealistic because gathering and transmission costs must be taken into account, but it lends considerable support to the belief that gas is priced far below its intrinsic value in comparison with other fuels.

Costs up.—Cost of exploring for gas, drilling wells, and laying gathering lines are going up rapidly, like everything else, and the rising trend of gas prices is getting important assists from the conservation authorities in producing states. To eliminate flaring and waste of gas, some of these states have forced producers to install gathering systems and natural-gasoline plants to strip the gas of liquid components. The residue gas is better for transmission purposes than unprocessed gas, but it costs the pipe lines a lot more than the 2 to 5 cents they paid for their original supplies.

Oklahoma and Kansas have minimum-price laws under which field prices of 7 and 8 cents per thousand have been set, and this has been upheld by the Supreme Court in the name of conservation. There is aggitation for a similar law in Texas, and a minimum field price of 10 cents is being talked for that state. Such laws force purchasers to revise old contracts which called for much lower prices.

New taxes.—New taxes are increasing gas prices, too. Texas has a new tax of 9/20 cent per thousand on gathering gas in the field. While this applies equally to gas for local consumption, the tax is being contested by a number of interstate transmission lines. Others advise against a court fight, arguing that if this tax is knocked out the Texas Legislature will write a new one which will stand up in court and it will be at a higher rate.

In theory and in law, transmission lines can increase their prices at the delivery end to cover all higher costs of gas and taxes. But this is easier said than done. Agencies regulating

I.N.G.A.A. OFFICERS.—Officers of the Independent Natural Gas Association of America elected at the recent Oklahoma City meeting, are, left to right: Paul Kayser, president, El Paso Natural Gas Co., Houston, president; J. F. Merriam, president, Northern Natural Gas Co., Omaha, first vice president; S. B. Irelan, president, Cities Service Gas Co., Oklahoma City, second vice president; and F. W. Peters, treasurer, Oklahoma Natural Gas Co., Tulsa, treasurer.

public utilities are notoriously slow in granting rate increases, and court actions and political pressures add to the delays.

Rate increases sought.—At present the Federal Power Commission has pending before it applications from interstate gas-transmission companies for rate increases aggregating between $90,000,000 and $100,000,000 annually, all based on increased field prices for gas and rising operating costs generally. When these new high city-gate prices are translated into the monthly bills the local utilities render their customers there may be a public outcry and possibly a lessening in the popularity of this fuel in areas where it has only recently been promoted.

The transmission companies are really worried that their gas costs may go so high as to encounter stiff consumer resistance. They can market unlimited quantities of natural gas so long as its delivered price is well below the equivalent heat value of other fuels. But if the delivered prices get above that of coal or fuel oil in northern and eastern cities, the days of easy expansion will be over.

Fear regulation.—The tendency of gas producers to hold out for higher prices is not the only factor keeping large reserves off the market. An even greater factor, in the case of many oil companies, is fear of federal regulation.

An interstate gas line is a public utility, and its earnings are limited to about 6½ per cent on investment less depreciation. For several years there has been agitation in Congress and in the Federal Power Commission to extend this utility regulation to producers of natural gas which goes into interstate lines. Some 18 months ago President Truman vetoed the Kerr gas bill which would have exempted producers from federal control, an action which greatly intensified the fear of regulation.

It is true that in its recent decision in the case of Phillips Petroleum Co. the FPC held that it does not have power to regulate the charges of independent producers and gatherers of natural gas. But the fear still persists. The Phillips case will be appealed to the courts, the personnel and attitude of FPC could change, or Congress could rewrite the law to impose regulation on gas sold for interstate movement.

For this reason, as well as the belief that gas will be worth considerably more a few years from now, many holders of large gas reserves are not anxious to make long-term contracts to sell their gas to interstate pipe lines. In fields where they can't keep their gas shut in, for one reason or another, they much prefer to sell to companies which distribute entirely within the state and thus are unquestionably beyond the reach of federal control.

New headaches.—A couple of brand-new headaches for transmission lines have just been cooked up by federal agencies.

One of these is price control by the Office of Price Stabilization. OPS has announced that it will intervene before the FPC and state and city utility-regulating bodies to protect consumers against unwarranted rate increases. Since regulatory agencies are charged by law with maintaining fair earnings for utilities, OPS may not accomplish much in the long run but its intervention could cause further costly delays in getting rates up to cover rising costs.

A more alarming move by OPS is its recent action vetoing the field price which an interstate line proposed to pay in East Texas. Here, in a new field close to the company's main line, the company contracted with producers to buy gas at 12 cents per thousand cubic feet, but OPS set a ceiling price of 10 cents, the same as contracts written at earlier dates in nearby fields. This policy may check inflation, but it does not induce producers to part with their gas.

Common carrier question.—The other curve recently thrown by the federal Government is the ruling of the Interior Department that any pipe line crossing government-owned land automatically becomes a common carrier. This means that the owner of gas near a pipe line could contract to sell it to a user farther along the line and force the pipe line to transport it even if it has to build new facilities or displace customers already under contract.

This is no theoretical possibility; it has already happened in one case. Pipe-line companies are fighting Interior in courts and in Congress, but the situation is a strong deterrent to the construction of new lines any place that might cross land owned by the federal Government—and that is almost everywhere these days.

The prospect of dwindling supplies of purchasable gas is turning transmission companies toward producing their own to take care of replacement and expansion needs. A number of them are setting up exploration and production departments or subsidiaries for this purpose. Some of the older pipe lines do own their reserves, or much of them, but the postwar lines have depended largely on contracts made with independent producers.

Tough legal spot.—But a transmission line producing its own gas is in a difficult legal spot. When it buys gas, at whatever price, the cost is entered as operating expense and the utility commissions must allow rates high enough to cover it. But when it produces its own gas the cost is treated as capital investment and profits are limited to 6½ per cent on investment less depreciation. Some of the older gas lines have depreciated their investment in gas reserves 100 per cent, so they are now obliged to enter their gas at zero value.

This might be all right in the case of a gas field acquired and developed long ago, but it precludes the possibility of building up funds for new exploration. Wildcatting for gas, as for oil, involves the risk of heavy losses in dry holes, and the wildcatter figures on offsetting such losses with

high profits on discoveries. An interstate pipe line under FPC regulation faces the prospect of standing the loss on dry holes but getting a maximum profit of 6½ per cent on its successful wells.

Another quirk.—Still another quirk of regulation is troubling the pipe lines. In Kansas and Oklahoma, which have minimum-price laws, some of them produce some of their own gas and purchase the rest. The FPC has allowed this minimum price on purchased gas and permits the lines to pay the one-eighth royalty on their own gas on the same basis, but will not allow the lines to value the seven-eighths of their own gas at the price fixed by the state.

The companies contend that by what they call "attribution" the gas they produce themselves should be valued at what the state conservation authorities say is the minimum price. They are fighting this attribution problem in the courts, but as the situation stands now it is a deterrent to further development of its own gas supply by an interstate pipe line.

Political agitation.—On top of all these factors working against the prospects of another big interstate transmission line, there is a strong political agitation in the Southwest to keep the gas at home. This is not new, but it seems to be gaining in strength.

Within the past month the governor of Oklahoma and the chairman of the Texas Railroad Commission have publicly expressed opposition to "exporting" any more gas from their states. Under the federal constitution there seems to be little they can do about this in the way of legislation, but by hampering and delaying tactics they could make trouble for a new interstate line.

But these states can develop local markets for their gas, by the usual chamber-of-commerce promotions and also by trading on the fear of federal regulation of those who sell gas interstate. This fear is so great that some producers will sell gas cheaper for intrastate consumption than prices being offered by interstate pipe lines.

Bearing fruit.—This campaign is bearing fruit, Sen. Robert S. Kerr of Oklahoma, who is a gas producer himself, says that in the 18 months since his Kerr bill was vetoed approximately $300 000,000 has been spent in the Southwest by industries using natural gas. He counts not only fuel users, but particularly petrochemical plants which use gas as the chemical raw material for producing synthetic nitrogen fertilizer, synthetic rubber, plastics, and a host of other chemical products.

Already, the senator says, gas consumption by petrochemical plants in the Southwest is between 5 and 10 per cent of the combined capacity of all the interstate pipe lines in the nation, and it is growing by leaps and bounds. A new aluminum plant in Texas uses as much gas as the entire city of Milwaukee, Kerr says, and a single chemical plant uses almost as much gas as Detroit.

"The resident of the North or East who cannot convert to gas heating this year can lay the blame on the shortage of steel if he wants to," Senator Kerr said, "but unless we are given a free gas-producing industry there won't be any more gas for the East from the Southwest no matter how much steel is available.

"The fast-growing industries of the Southwest will already have grown so big that they will take all the gas that can be found and they will have the first chance at it because when the producer sells his gas for consumption at home there is no question about regulation."

Time will tell.—Time alone will tell the accuracy of Senator Kerr's prediction, but the situation all adds up to a rather dim prospect for any promoter setting out today to assemble the financing and the gas reserves for another big interstate gas transmission line.

TECHNOLOGY

Crude Warmer

New electric method keeps paraffin in liquid state

D. H. Stormont

LOS ANGELES.—An electric warmer to make oil wells flow better by keeping paraffin and asphalt in a liquid state has been developed by a Los Angeles inventor.

The method sends low-voltage, high-amperage alternating current down the well to induce heat at points where paraffin and asphalt congeal. It has been tested successfully on paraffin crude in Wyoming and will soon be tried on asphalt crude in California.

Good results were shown in a 15-month test in West Mush Creek field of Weston County, Wyoming. Paraffin deposition is unusually severe in pumping wells of this field, as is the case in most Rocky Mountain fields. At the well where the method was tested, on the Jansen lease of J. A. Cronin, paraffin comes out of solution and deposits in the tubing at a depth of about 1,500 ft. The well's oil production thus is restricted and periodically must be scraped.

Costs low.—Using field-generated electricity, the new method was used to keep the paraffin in a liquid condition at all times. Average power cost during the test was about 3 cents per barrel of crude produced. Before heating was applied the well's production averaged about 32 bbl. daily. During the period of the test, from May 1950 to August of this year, daily production was reported by the operator as averaging 105 bbl.

As illustrated in the accompanying sketch, wire connections are used only to the well head—the tubing and casing conduct the low-frequency current down the well. Because of the high amperage, only a slight voltage drop is experienced due to conductor resistance.

Water used.—Heating medium is a column of water, about 10 ft. in height, between the tubing and casing. A conventional tubing packer is used to trap the water at the depth just below where paraffin comes out of solution. Neoprene spiders placed at about 100-ft. intervals insulate the tubing from the casing.

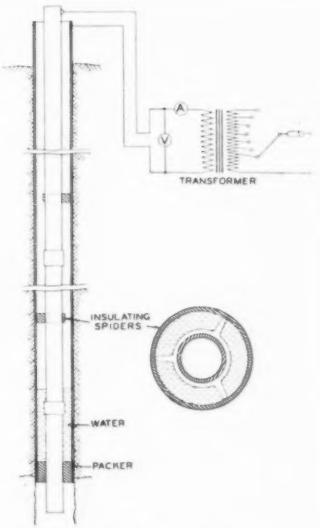


Diagram of wiring in electric heater method.

At West Mush Creek a truck-mounted, gas-engine driven generator was used for supplying almost continuous power. This was converted to 5-volt, 1,000-amp. current in a truck-mounted generator.

The method, patents for which have been applied for by its inventor, Dr. Samuel Spitz of Los Angeles, also shortly will be used as an asphalt liquefier in producing wells. In Huntington Beach and several other California tar-sand fields, deposition of asphalt is quite severe. Tests also are to be conducted with flow lines, using a water jacket, and on lease tankage where it is desired to keep asphalt from solidifying in the tanks.

Spraberry Puzzle

How to best produce oil from big trend and at the same time save on tubular goods has operators in a quandary

Roy F. Carlson

MIDLAND.—A program to save steel by curtailing drilling in the vast Spraberry trend of West Texas will be presented to operators in the area here next week.

A preliminary meeting of interested operators was held in Fort Worth September 26, and a nine-man committee was appointed to draft specific proposals. This committee was to meet in Fort Worth October 4 and was instructed to call a further meeting of all operators in Midland sometime during the week of October 8.

The movement is spurred by word from Washington that the Petroleum Administration for Defense cannot allocate steel to develop the entire trend on the present drilling pattern of one well to 40 acres, and that PAD is working out an allocation formula for Spraberry which is not satisfactory to the operators. To forestall federal control, the operators hope to evolve their own formula which will be adopted by the Texas Railroad Commission and will be acceptable to PAD.

The Spraberry trend, which already extends into four counties and may reach four more, is being drilled up on 40-acre spacing under the field rules established for Tex Harvey, Germania, and other early fields producing from this pay. Last July Magnolia Petroleum Co. asked the Texas Railroad Commission to order 80-acre spacing on a large area of the Spraberry trend in order to save steel. This was rejected by the commission because of objections from other operators that this would change the field rules under which a considerable portion of the area is already being developed.

Independent calls meeting.—The Fort Worth meeting last week was called by Arch Rowan, independent operator of Fort Worth. In an opening statement he said:

"The development of the Spraberry trend in West Texas poses one of the most serious problems that has faced the Railroad Commission and the oil industry in Texas. It is believed that the productive area may cover more than a million acres; in fact, a million acres is now regarded as semi-proved, with 500,000 acres already believed to be proved."

The effect of the Spraberry on the steel situation was pointed out by Rowan who said that with the current development program it would take 25,000 wells to develop the trend—1,000,000 acres on 40-acre spacing. Including all allied uses for steel such as tanks, line pipe, pumps, plants, and tubing and casing, Rowan estimated that it would require a total of 4,590,000 tons of steel, or an average of about 184 tons per well. With 80-acre spacing, he said, 2,250,000 tons of steel would be saved—enough steel to supply all of West Texas' normal needs for 3½ years.

Best method.—With few exceptions, operators agreed that the best method of steel conservation would be to reduce the density of drilling in those areas where possible without working hardship on operators who have already drilled to a 40-acre pattern. Most of the operators favored an 80-acre pattern, with some suggesting 160 acres.

Operators were also reminded that PAD officials, although not eager to do so, felt that they had authority to order some wider spacing pattern in the interests of conserving steel. Another policy of PAD would allocate one string of pipe each quarter of a year for each 800 acres of leases held by an operator. On this basis, it would take 5 years to develop that lease.

A solution to the problem is made even tougher because of different degrees of development by different operators. Some leases have been developed fully while offsetting operators have only begun to meet offset obligations, and in some cases they cannot meet them because of lack of casing.

Committee named.—Operators decided that steps should be taken immediately toward finding a solution and appointed a committee of nine men to study various methods of dealing with it. The committee consists of J. Howard Marshall, Ashland Oil & Refining Co., Ashland, Ky., chairman; Walter Goldston, Goldston Oil Corp., Houston; Jeff Montgomery, Ted Weiner Interests, Fort Worth; Ira Butler, Fort Worth attorney for York & Harper, Midland; W. P. Z. German, Jr., Midland attorney; Carl Reistle, Jr., Humble Oil & Refining Co., Houston; D. V. Carter, Magnolia Petroleum Co., Dallas; Jack Roth, Tide Water Associated Oil Co., Tulsa; and E. H. McCollough, Amerada Petroleum Corp., Tulsa.

The operator's committee during a short preliminary session decided upon a general plan of action, and firmly agreed upon only one thing: That no recommendations as to change in field rules would be made for any of the trend north of a line at least as far south as the south line of Township 3 South of the T&PRR Co. Survey: This would exclude Germania and Tex Harvey pools, already developed to a large degree on 40-acre spacing.

One of the suggested methods of achieving wider spacing would have development follow a general 80-acre pattern, with the operator having the option of drilling one or two wells on the acreage. The first well would be given the present 40-acre allowable of 121 bbl. per day. If a second well were drilled, its allowable would be determined by some formula based on both the well and on acreage.

PAD position.—Following the operators' meeting, PAD officials in Washington denied any intention of imposing any controls on Spraberry beyond those necessary to insure equitable distribution among all producers of the limited amount of oil-country tubular goods available.

In view of the size of the field and other factors, they explained, they believe Spraberry should be developed over a period of 5 years and are making tubular-goods allocations on that basis. To develop it at a

SPRABERRY TREND DATA
(September 25)

Possible acreage—2,000,000.
Semiproved acreage—1,000,000.
Considered proven acreage—500,000.
Counties involved—Midland, Upton, Reagan, Glasscock now producing; Martin, Dawson, Borden, Howard may be in trend.
Average depth—7,000-8,000.
Producing zones—Two (upper and lower Spraberry).
Kind of pay—Low porosity, low permeability, calcareous and silty sandstone with extensive vertical fracturing.
Gravity of crude—37° A.P.I. plus or minus 4°.
Gas-oil ratio—750:1 average, low of little more than 300.
Bottom-hole pressure (72 hours shut in)—1,900 psi. average producing wells.
Drilling cost per foot—$6; $500 per day day-work rate for rotary drilling-in unit plus pipe rental.
Completed cost per well—$80,000-$100,000 per well.
Separate producing area—15 in the four producing counties.
Total number of wells (above four counties)—522.
Recovery estimates—Vary from low of 1,800 bbl. per acre to a high of 10,000 bbl. Usual figure about 3,000.

faster pace, they declared, it would be necessary to devote an undue percentage of available steel to that one area which would entail a cutback in operations in other parts of the country.

On the 5-year basis, PAD is allocating steel to operators in the field at the rate of one well per 800 acres quarterly. Thus, over a period of 5 years the field would be drilled on a 40-acre basis. No effort is made to tell operators where or how they should drill. The last report received in Washington showed around 369 rigs operating.

Many operators have agreed with PAD that a 5-year drilling program would be in the best interests of the industry as a whole and some have agreed to cut back programs which contemplated quicker development, it was said.

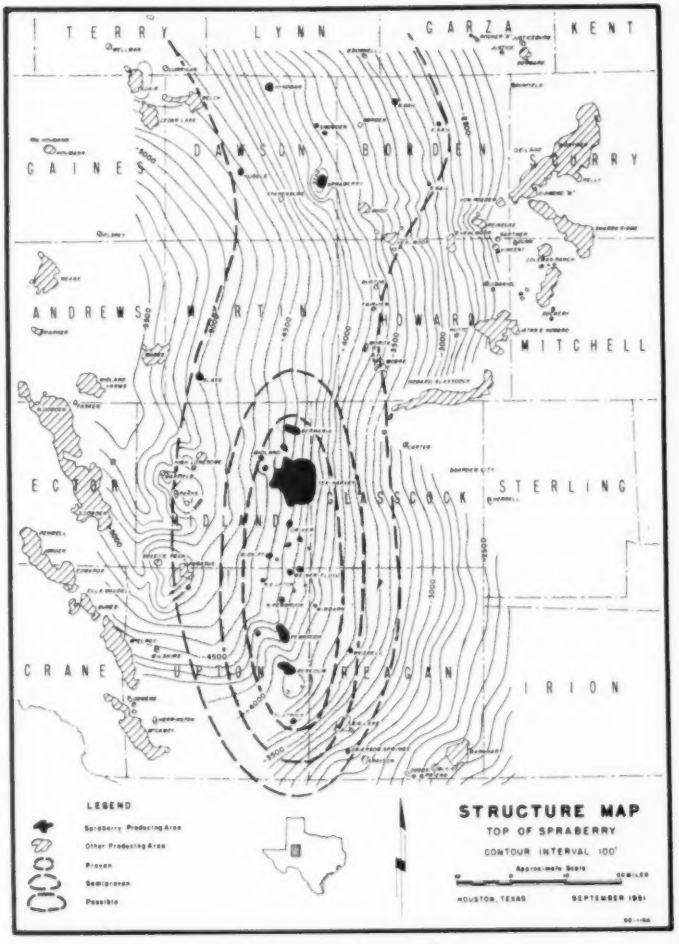
Officials said that if operators go along with the plan PAD will make every attempt to keep them supplied with tubular goods. However, if operators flout PAD and go ahead with intensive drilling they may find themselves deprived of materials until the field as a whole catches up with them.

Available steel.—There are only about 300,000 tons of tubular goods available for all the operators in the country and a drive to develop Spraberry in quick time would require a sizable part of that supply. One operator, it is reported, asked for 1,000 tons of tubular goods for his own immediate operations and the projected operations of a handful would require so much material, if their requests were granted, that the drilling program nationally would be disrupted.

Attitude changing.—In Midland the general reaction to the Fort Worth meeting was that many Spraberry operators are changing their attitude toward existing field rules as a result of the PAD plan to curtail steel allotments. Many of those who attended the meeting, including some who are serving on the committee, represent interests who opposed any changes when the railroad commission held its hearing on Magnolia's request for 80-acre spacing on July 19, and again on August 17 when the commission held a hearing on its own proposal to reduce the allowable of Spraberry wells.

At the spacing hearing Magnolia requested a 1-year experiment to see if a single well would drain 80 acres adequately, and proposed a formula for locations and allowables which would permit a return to 40-acre spacing at a later date. Magnolia was supported by a number of other major companies, but opposed by many independent operators.

Charging that the proposal had nothing to do with preventing physical waste but was a device to permit big companies to hold large tracts without being obliged to drill many wells, the independents told the commission that Spraberry is the largest single source of quickly available oil and that national defense will be served better by drilling it up quickly than by using the same tonnage of steel in wildcatting.



Structure map of the vast Spraberry trend in West Texas.

Present allowable.—The present allowable is 121 bbl. per day from a Spraberry well on a 40-acre tract. The commission proposed to cut this to 83 bbl. per day, but has taken no action since the hearing. Magnolia asked that the allowable for each well be doubled under 80-acre spacing, contending that this would produce just as much oil, but the independents disputed this, pointing out that some Spraberry wells at present can make only 50 to 65 bbl. per day.

Opponents of wider spacing introduced evidence to show that the reservoir energy in the Spraberry is solution gas drive, and that in this type of field a drop in pressure below the bubble point will cause the drainage area to shrink and the heavy ends of the crude will be deposited in the formation. They argued that maximum recovery would be obtained with close spacing and high allowables. Some said that 20-acre spacing might be needed for proper development of the Spraberry.

Special interest.—In addition to its huge extent—some predict the spread will ultimately cover 2,000,000 acres—the Spraberry sand is of special interest because of the tightness of the formation and the fact that it is broken by peculiar vertical fractures. Some say the Spraberry holds more oil than East Texas, but recovery presents many unsolved problems.

The oil apparently bleeds into the

fractures and then drains into the well, and the channeling permitted by the fractures allows the solution gas to bypass the matrix of the sand. This condition may make it impossible to apply pressure maintenance or water flooding, and it also imposes special methods of well completions.

These odd fractures sometimes have been found to run the full length of a 50-ft. core, and often the core splits into two pieces when taken from the core barrel. In one well of Humble Oil & Refining Co. the casing was cemented at the top of the Spraberry and subsequent core drilling showed that the cement had followed down the fractures as far as 90 ft. below the shoe.

To avoid plugging and contaminating the fractures, operators are experimenting with various completion methods, including the use of oil instead of mud, oil-base or oil-emulsion muds, compressed air, and cable tools. Some believe that if water or mud in any form is allowed to reach the formation it will cause a "peel off" of the fractures.

Monocline.—The Spraberry formation is a monoclinal structure with an average dip of only 100 ft. in 3 miles, and without pronounced local variations in dip. It is believed to be a continuous reservoir or stratigraphic trap, possibly bounded on the east and west by shaling up of the sand or the absence of extreme fracturing. The pay sand is usually found at about 7,000 ft., and has an average thickness of 225 to 260 ft. There is also a lower Spraberry sand and some wells have been dually completed, but greatest interest currently is in the upper pay.

There is no evidence of a gas cap and the reservoir apparently is gas saturated now and probably was originally. There probably is no water drive, and the water level appears to be erratic.

The Spraberry sand has such low permeability that it probably would not produce if it were not for the fractures. Wells usually must be shot or treated with the Hydrafrac process to make them good producers.

Core samples.—Core data admittedly do not show the true condition of the reservoir since they are based on the matrix only and do show the porosity and permeability of the fractures. The average porosity of one group of cores ranged between 2.5 and 15.8 per cent. Core samples have shown permeability ranging from 0.1 to 5.5 md. and the average has been estimated at from 0.3 to 0.46 md. Calculations from productivity indexes, however, indicate an average permeability of 6.48 md., or 14 times as great, due to the presence of the fractures. One engineer estimated that 95 per cent of the flow capacity of the reservoir can be attributed to the fractures, although the storage capacity of the fractures is only 0.35 per cent compared with 99.65 per cent for the matrix.

Productivity indexes of 14 wells in Tex Harvey and Germania fields ranged from 0.08 to 0.83, and averaged 0.36. Some bottom-hole pressure-flow tests indicate productivity indexes will average about 0.3 bbl. per day per pound drop in pressure, and which results in a very low specific productivity index per foot.

B.h.p.—Bottom-hole pressures range from 1,420 to 2,320 psi., and are believed to average around 1,800 or 2,000 psi. for the entire Spraberry trend. The gas-oil ratio has been found to vary from 300:1 to 1,000:1, and is believed to average about 750:1.

The bubble point, or saturation pressure, is believed to be about 1,950 psi. One bottom-hole sample in Germania field at a sampling pressure of 1,945 psi., indicated a bubble-point pressure of 1,920 psi., a reservoir volume factor of 1.421, viscosity at the bubble point of 0.67 cp., and a solution gas-oil ratio of 735:1. At the bubble-point pressure the reservoir volume factor was 1.416 and the solution gas-oil ratio was 845:1.

Such data, coupled with the known facts about the low permeability of the matrix sand and the channeling effect of the vertical fractures, have been interpreted by some engineers as indicating that maximum recovery from the Spraberry cannot be obtained without fairly close spacing and a rather high rate of production. On the other hand, the low ultimate recovery indicates that wide spacing is best from the economic standpoint.

Difficult question.—The peculiarities of Spraberry thus pose difficult questions for the operators, PAD, and the Texas Railroad Commission. The commission rejected Magnolia's request for 80-acre spacing in part of the trend on the ground that it would upset the drilling pattern already established for certain fields, but it is quite probable that the commission will reconsider the question if requested by PAD and a representative group of operators.

Production Problem

Crude output, flaring to highlight October 9 meet

AUSTIN.—High crude production to offset British losses in Iran and the problem of gas flaring at natural-gasoline plants promise to be controversial subjects before the Texas Railroad Commission at its next statewide allowables hearing, to be held in Beaumont October 9.

Appalling waste of gas is being caused by the high rate of crude production which was established at the request of government officials because of the Iranian shutdown, Ernest O. Thompson of the Texas Railroad Commission, declared in a letter to Secretary of State Dean Acheson. The tone of the letter suggested an inclination on the part of the commission to reduce November allowables.

At the same time it was learned from Washington that the Petroleum Administration for Defense will ask Texas and Louisiana to maintain their current producing rates in order to fulfill the schedule of deliveries of crude and products to Europe which PAD has worked out with companies operating abroad.

Flaring data sought.—Chairman Olin Culberson of the Railroad Commission last week telegraphed all gas-processing plants in West Texas to furnish information on both wet and residue gas being flared, stating that this information is to be used at the Beaumont hearing. This followed Culberson's earlier announcement that the commission was considering action to reduce flaring *(The Oil and Gas Journal, September 27, 1951, page 51)*.

Thompson's letter questioned whether the State Department is giving adequate consideration to the drain on our natural resources to fill the gap in European supplies left by Iranian oil. Increases in oil production, he said, have brought an increase in the production of casing-head gas beyond the capacity of processing plants to handle it, with the result that both processed and unprocessed gas is being flared.

"The situation is so imperative that I thought it not amiss to call your attention to the terrific damage that is being done to Texas in waste by reason of our efforts to take care of a situation over on the Persian Gulf," Thompson wrote Acheson.

PAD officials in Washington have stated that progress is being made in meeting the loss of Iranian oil and the situation is improving without as heavy a drain on United States supplies as was anticipated earlier. However, they believe production in this country should be continued at its present rate and be increased as programed, in both crude and products, so that stocks may be built up over the next 2 months against winter needs and so that depleted European inventories can be rebuilt. The latter have an important military as well as economic significance and are of concern to defense officials since oil is an important military weapon.

Current allowables.—Texas' crude-oil allowable for October was set by the Railroad Commission at 3,115,512 bbl. daily, highest in the state's history *(The Oil and Gas Journal, September 27, 1951, page 51)*. The Oklahoma allowable was set by the state corporation commission at 504,095 bbl. daily, up 4,190 bbl. daily over September; Kansas' permissable pro-

duction was set at 310,000 bbl.; and Louisiana's, 653,370 bbl.

A statewide hearing will be held in New Orleans October 11 by the Louisiana Conservation Department to determine allowables for November and December.

Water "Flood"

Humble revamps wells for "underwater" production

SWEETWATER, Tex. — Water "encroachment" has presented a new producing problem in Fort Chadbourne field of Coke County, Texas, 30 miles south of here, but Humble Oil & Refining Co. thinks it has the problem licked.

The encroachment in this case is not the type which ordinarily causes production troubles. This time it is in the form of a 16-ft. body of water which will inundate three of Humble's producers when a new water reservoir is completed in the area.

The three wells on Humble's leases, the Sallie Odom 1 and 4, and the Odom State 1, have had to be prepared in such a way as to produce in spite of this approaching water.

To prepare for the inundation, crews killed each of the wells by inserting water into the hole to fill the 5½-in. casing and 2-in. tubing. In each case, the christmas tree was unflanged and a caisson set over the well head.

Caisson used.—Caisson is a 3,000-lb. steel cylinder 16 ft. high and 5 ft. in diameter, with an internal ladder to give access to ground-level fittings. At the No. 4 well, only a 10-ft. rise was necessary.

The caisson was bolted to a previously prepared concrete footing and then an extra piece of casing was flanged onto the well pipe to extend the well head just as high as the caisson. The tubing was similarly extended and finally the christmas tree was lifted into position. The wells were then swabbed to start up production.

While new fittings were being made up, earth-moving equipment was used to build a stone-reinforced ramp from the wellsite to the highway, running along the edge of the projected lake.

Ramps were enlarged into 200-ft. circles around the wells to provide for working space for future servicing. The tank batteries have been placed on high ground overlooking the reservoir site.

CHRISTMAS TREE RAISED.— Replanted christmas tree on Humble Oil & Refining Co.'s Fort Chadbourne field well has been lifted 16 ft. because of a new water reservoir which will flood the area. An earthen peninsula will be built around the caisson to connect the wellsite and a nearby highway.

INDUSTRY AFFAIRS

Hard-Rock Drilling

Problems yielding to research but much remains to be done before real progress can be reported, A.S.M.E. told

Joseph A. Kornfeld

PROBLEMS of drilling through hard rock formations are yielding to research but much remains to be done before real progress can be reported.

Such was the gist of the papers and discussions at the drilling symposium of the petroleum division of the American Society of Mechanical Engineers at Tulsa September 24-26, where the principal topics were the Bassinger percussion drill and the mechanical properties of hard formations.

Recent experiments with the Bassinger drill have shown very considerable increases in penetration rates and savings in drilling costs, it was reported by Ross Bassinger, president of Bassinger Tool Co., San Antonio. The design of the tool has been improved by reducing the weight of the hammer element and by operating drill at an average frequency of approximately 900 strokes per minute instead of at around 300 strokes.

Penetration rates of 1 ft. per hour in chert were reported by Bassinger, who said that the greater the concentration of chert in the strata, the greater the efficiency. He said that chert is so hard and friable that it readily yields to percussion drilling.

Problems remain.—H. E. Gray, Shell Oil Co., Houston, described the development of the Bassinger drill as a tool for use with solid-head percussion-type bits as a project worthy of consideration but that development of a down-the-hole tool such as this may turn out to be quite a long-range project. He said that little is known about the relation between frequency of tool movement, hammer weight, and penetration rates in different formations, and that the performance limit of this type drill has not been reached.

He believed that a major problem in the development of the Bassinger drill will be that of control. In one particular installation, the driller must be able to control the position of the slip joint at will. Since it is impossible to carry a load on the bit with this tool, no help can be had from the weight indicator. The position of the slip joint, must, however, affect the pressure, and therefore it may be possible to design a suitable feed-off control which will take its signal from the surface mud pressure.

Increases in rates of penetration and bit life have been recorded and such increases are encouraging, in the words of W. R. Johnston, Humble Oil & Refining Co., Houston, whose discussion of the Bassinger paper was read by J. G. Walvoord. However, the problems of shale caving, operating expense, specialized operation, and loss of rig time, encountered while using a percussion drill, may offset any gain in drilling rate. Johnston said that the Bassinger drill or a similar device using solid head bits may be the answer to hard formation drilling.

Rock "hardness." — In the discussion on properties of hard rocks, W. B. Mather, who heads up the work on mineral technology of the Southwest Research Institute in San Antonio, criticized use of the term "hardness" as applied to rocks and said that the usual definition of this term is often belied by drilling results obtained in the field.

He suggested that the term "penetrability" be used in discussions of

DRILLING SYMPOSIUM.—Principals at the session on drilling practices at the A.S.M.E. convention were, from left to right: J. R. Mahan, National Supply Co., Toledo, vice chairman; R. Bassinger, Bassinger Tool Co., San Antonio; R. E. Edwards, Gardner-Denver Co., Quincy, Ill.; and J. E. Orrell, Shell Oil Co., New Orleans, chairman.

rock penetration rather than hardness. In this way, a rock of specific mineral composition would be penetrated at a definite rate under a specific type of drilling procedure. The term would be all-inclusive, applicable to jet piercing, as well as to any other future method of rock penetration.

Totally ignored in studies of drilling problems are tensile strength and elasticity of rocks and minerals as well as those of the drilling tools themselves, Mather said. These particular properties are two of the most factors governing drilling of any type, he said.

Abrasion. — In the case of diamond drilling where abrasion is believed to be the governing factor, other variables exist which modify drilling penetration rates. For example, it has been said that finer-grained rocks are more difficult of penetration than are coarser-grained rocks of identical mineral composition. However, Mather said that the only apparent difference in these two rocks is the existence of more grain boundaries in the finer-grained type. The inference was that grain boundaries exhibit a greater resistance to abrasion than does the interior of the grain.

Properties which exhibit a marked effect on abrasive hardness other than rock texture include degree of cementation, variation in mineral content, and the existence of incipient fractures.

Proof that physical properties other than abrasive hardness are of major importance in penetration rate studies is afforded by case histories cited which show that chert, a rock of highest abrasive hardness, occasionally cuts more rapidly with a diamond drill than does fine-grained limestone.

"Fast Control Loop"

This achievement of better refinery operation is made possible by proper instrumentation use, A.S.M.E. hears

John C. Reidel

BETTER refinery operation can be achieved by proper use of new methods of instrumentation to achieve a "fast control loop," the petroleum division of the American Society of Mechanical Engineers was told at its meeting in Tulsa September 24-26.

A prime factor in obtaining speedy control of operations is the elimination of long transmission lines between measuring instruments and controlling instrument, which can be done by combining the two instruments into one which is located on the valve to be controlled.

The method was described by V. V. St. L. Tivy, of Foxboro Co. Modern refinery operations call for control to within a fraction of one degree, Tivy said, whereas instrumentation systems designed a decade or so ago permitted a variation of several degrees in process temperature.

Flow control.—Noting that flow controllers comprise over 50 per cent of all controls used in a refinery, Tivy said flow control is an item of prime importance to refinery operators since poor flow control may be the cause of instability in operation of fractionators, tube stills, and other equipment.

Poor flow control, he said, may be due to the long air-transmission lines used to actuate the instruments. One way around this difficulty is a line compensator, with or without a volume relay, mounted on the control valve to minimize the transmission lag.

Direct control.—The basic solution offered by Tivy was elimination of the transmission line by placing the controller on the valve. This meant that a suitable controller had to be developed that would stand service in the field, that is in the vicinity of the operating unit rather than in the shelter of the control room. By removing those portions of the mechanism used to obtain adjustable settings or proportional band and reset time a rugged, compact controller was developed.

Proportional band or "throttling range" is the percentage of the full controller scale range, as shown on the recording chart, which is required to move the control valve through its full travel from fully open to fully closed. Reset rate refers to the rate of valve movement per unit movement of the recording pen. In conventional controllers provision is made for adjusting proportional band and reset rate so that the controller is "tuned" to the process. In the controller described by Tivy an arbitrary proportional band, say of about 100 per cent, is chosen and the controller operates with this fixed setting.

Use of the new controller and consequent elimination of long transmission lines, Tivy stated, makes for easy startup of refinery units and minimizes instability due to the superior flow control obtained.

Faster instruments.—To meet present refinery requirements, Tivy reported, new instruments have been developed which have greater sensitivity, or ability to show a change of small magnitude, and also greater speed of response which enables them to react to a change more quickly.

The payoff to the refiner who takes advantage of the benefits obtainable with the newer measuring devices was illustrated by a number of actual cases. One instance involved temperature difference control on a large deisobutanizer with temperature resetting the reflux flow controller. Through application of very sensitive instruments responding rapidly to small changes, temperature was maintained to within fractions of 1° F on a total chart span of 20° F.

Fast control loop.—Unfortunately, Tivy continued, there are modern refinery units being built today in which full advantage is not being taken of the newer, "fast" instruments. Patchwork application of automatic control must be avoided, he said, and consideration of the instrument system must begin with the process design and must include the complete control loop. The object is to obtain a "fast" control loop. Advantages derived from "fast" instruments may be lost if these are

PLANT INSTRUMENTATION.—Modern applications in refineries were reviewed by this A.S.M.E. group. From left: C. E. Balcerzak, Bureau of Mines, Louisiana, Mo.; V. V. Tivy, Foxboro Co., Foxboro, Mass.; A. J. Hanssen, Black, Sivalls & Bryson, Tulsa, chairman; R. E. Loebeck, Phillips Petroleum Co., Bartlesville, Okla., vice chairman; and J. M. Ribble, Phillips Petroleum, Bartlesville. J. A. Skillern, Bureau of Mines, coauthor, was not present when the picture was taken.

grouped with others which are "slow."

Basic component parts of the control loop are the process itself, the measuring device, transmission lines, the controller, valve line, and the control valve.

The measuring element senses a change while the controller does something about it. A change in some process variable such as flow, temperature, pressure, or liquid level is transmitted as an input signal to the controller where it is converted to an output pressure that acts to open or close the control valve. It is obvious that the component parts of the control loop must be considered not only individually but also in relationship to each other and the overall control scheme.

New Cement

Clay product seals porous formations, A.I.M.E. told

OKLAHOMA CITY.—A new time-setting clay cement to seal off porous and cavernous formations while drilling wells has been developed by Magnolia Petroleum Co. and successfully used in field tests, company engineers reported to the petroleum branch of the American Institute of Mining and Metallurgical Engineers, meeting here October 3-6.

One of 34 technical papers on drilling and producing technology and reservoir engineering, the paper on the new corrective for lost circulation was delivered by T. A. Pollard, J. U. Messenger, and J. S. McNiel, Jr., all of Magnolia's field research laboratories in Dallas.

Losses of drilling muds up to $50,000 per well are sometimes incurred when oil wells are drilled through fractured or cavernous underground formations, they said, and industry-wide costs which can be traced directly to lost circulation of muds run into the millions of dollars annually. To offset such losses, the new clay cement developed by Magnolia can be employed.

New product successful. — Magnolia has found that the new time-setting clay cement has been successful in field tests for plugging off mud-loss zones where other more conventional materials failed. Basically, the new clay cement consists of an aqueous slurry of a specially selected clay, a smaller amount of an aluminate silicate to increase the strength of the clay after it sets, and a retarder for increasing the time during which the slurry can be pumped before it starts to set.

The magnolia engineers explained that the new clay cement is preferably placed in a well by standard cementing equipment where the solids and water are jet-hopper mixed and then pumped directly into the drill pipe. In a relatively short time after the mixture is pumped down to the permeable zone, the clay cement becomes plastic with sufficient strength to seal off the zone against mud losses during subsequent drilling operations.

Gas Line Opened

Trunkline's project is finished 1 month early

TUSCOLA, Ill.—Gas began flowing this week through the $80,000,000, 1,300-mile, 26 and 24-in. natural-gas line of Trunkline Gas Co., a month ahead of schedule.

Ceremonies here September 30 officially opened the new line and turned gas into the Hugoton field-to-Michigan system of the parent company, Panhandle Eastern Pipe Line Co.

Delivery of the gas, gathered along the Texas and Louisiana Gulf Coast, marked the climax of a Panhandle Eastern expansion program begun more than 2 years ago. Completion of the new line increases the Panhandle system's capacity to 850,000,000 cu. ft. per day, of which 250,000,000 cu. ft. will be suppled by Trunkline.

Until this week, Panhandle's gas had come entirely from Panhandle and Hugoton fields in Oklahoma, Kansas, and Texas.

The line. — Gas gathered in Gulf Coast fields is moved from McAllen, Tex., to Lake Charles, La., via a 24-in. line. From Lake Charles to Tuscola, Ill., the line is 26 in. in diameter.

There are four compressor stations along the route with a combined horsepower of 32,000.

A certificate for the line's construction was granted in May 1950. Survey of the route began in early June, and on June 21 contracts were let for its construction. Clearing of the right-of-way began on July 24, 1950.

The project involved the laying of 276,743 tons of pipe. Work involved 1,490,000 man hours.

WEST COAST

Midway Monument Dedicated

BAKERSFIELD, Calif.—A historical marker commemorating discovery of the famous Midway field 40 miles southwest of here has been dedicated by the Petroleum Production Pioneers.

The marker is first of a series denoting sites and events significant in the history of the California petroleum industry.

In Midway field, as tableted on the monument, Chanslor-Canfield Midway Oil Co. No. 2-6 "Well," "the well which made the Midway oil field famous, blew in over the derrick top November 27, 1909, with a production of 2,000 bbl. a day and started one of the greatest oil booms California ever experienced."

Previous to completion of the gusher, only small 40 and 50 bbl. wells had been found in the surrounding area.

Fred C. Ripley, retired general manager of C.C.M.O., who staked location for the No. 2-6 well and supervised early development there, recounted how the site was selected and difficulties encountered in the drilling.

Ralph Arnold, who prepared the geological map used by Ripley in locating the well, was present at the dedication, which was sponsored by Petroleum Production Pioneers.

L. L. Aubert of Bankline Oil Co. and president of P.P.P., gave the memorializing address and unveiled the monument. Ted Sutter of Baker Oil Tools, Inc., past P.P.P. historian, and Paul Andrews of Signal Oil Co., current historian, also gave brief addresses.

Steel Hearing Planned

Senate committee may call on defense-agency officials to explain steel allocations to oil, natural-gas industries

WASHINGTON. — Defense-agency officials may be called before the Senate interior affairs committee this month to explain their allocations of steel for the oil and gas industry, if time permits before the adjournment of Congress.

An examination of the manner in which decisions have been reached as to the amount of steel to be allowed the industry is planned by Sen. Joseph C. O'Mahoney as soon as his committee disposes of the tidelands legislation and one or two other matters now before it.

The avowed purpose of the inquiry is to secure a larger appropriation of material, particularly for the production and transportation of oil and gas. O'Mahoney has long been concerned over the situation and early this year held a hearing at which facts were developed regarding the then steel position and outlook, but conditions since have changed so materially that he believes it should be gone into again.

Outlook no better.—The outlook for the first quarter of 1952 is no better than the allocation for the current quarter, Petroleum Administration for Defense officials said. Negotiations are now going on with Defense Production Administration officials regarding the supplies to be earmarked for oil and gas, but indications are PAD will be doing well if it can secure as much as it now is getting. Since the military requirements for the first quarter are expected to jump from 1,500,000 to 2,500,000 tons out of a total expected availability of 19,000,000 tons plus, allocation of as much for oil and gas as PAD is getting now would actually represent an increase percentagewise.

Meanwhile, it was disclosed that in cutting the industry to 75 per cent of its requirements officials of DPA took what they called a "calculated risk" that industry operations might dry up under a starvation diet.

The fact that DPA was gambling on the industry's ingenuity and efficiency to meet programmed requirements on an inadequate supply of steel was brought out in a "briefing" session of editors from all sections of the country at which defense officials discussed the progress of the mobilization program.

PAD warning.—At the same meeting, however, Deputy Petroleum Administrator Bruce K. Brown, while declaring that the loss of Iranian oil would not of itself necessitate rationing in this country, warned that the oil industry will not be able to go along indefinitely with an ever expanding development program unless it is given the tools with which to work.

Although officials in Washington are confident that, barring some unforeseen development, there will be no rationing in the near future, New England fears of a fuel-oil shortage next winter continued to mount and a Senate subcommittee is preparing to make a study of the prospects. Spot shortages are expected to develop in other areas also during the next 6 months, particularly if they experience rigorous weather.

TEL picture brightens. — The tetraethyl-lead picture has brightened perceptibly with reports that Ethyl Corp. and Du Pont have made substantial purchases of metal abroad to eke out the badly cut allocations of the National Production Authority. To secure these supplies, however, the companies had to pay several cents more a pound, since the ceiling price of domestic lead is considerably under the world price.

Allocations of soft primary lead for TEL manufacture during September were only 40 per cent of requirements and October allocations are also far below normal needs. PAD has urged NPA to increase the allocations, which represent about one-third of the total lead used in TEL, the remainder coming from imports and scrap.

Brown disclosed that he was urging that TEL manufacturers be given allocations of lead on the basis of the historical supply pattern, warning that unless such assignments are made civilian automobile owners may suffer.

Reduction impracticable.—Brown explained that it is obviously impracticable to reduce the use of TEL for military purposes or divert fluid from the reserve supply being built for emergencies. Consequently, he said, any cut in TEL production would have to be borne almost completely by civilian automotive gasoline.

Although the companies' purchases abroad are reported in some quarters to be sufficient to keep them going for most of the remaining year, Brown was less optimistic.

"We are hopeful that no extraordinary action will be needed," Brown said. "Certainly it appears that none will be needed in October, but for the rest of the year we will have to keep our fingers crossed."

Lube-oil problems. — While the TEL situation thus appears to have been brought under better control, at least for a time, new problems have arisen in the field of lubricating oils and PAD is seeking to have DPA formally program an expansion of 15,000 bbl. daily of high-viscosity lubricating oils and 8,000,000 lb. a month of detergent-type additives.

If this expansion is officially sponsored, projects to bring it about would be eligible for certificates for accelerated amortization and would also be in a position to get scarce materials if it became necessary to limit their use to programmed operations. Applications for accelerated tax amortization for facilities for nearly 6,000 bbl. daily of high-viscosity oils and a major portion of the needed additives already have been filed with PAD.

New PAD Powers

Authority is increased to insure supply for defense

WASHINGTON.—Complete authority to insure supplies of oil and gas for the defense effort was vested in the Petroleum Administration for Defense this week by Interior Secretary Oscar L. Chapman.

Under the provisions of PAD Regulation No. 1, the agency is empowered to issue directives to require adjustments in the distribution of oil, petroleum products, gas, and other material under its jurisdiction and may require, forbid, or otherwise provide for deliveries.

The purpose of the regulation is to enable PAD to instruct members of the industry to do things which they might be reluctant to do for policy or legal reasons.

The intent in issuing it at this time was to permit the agency to take steps to meet shortages in supplies of Navy special fuel oil, which it did in two separate directives to companies with operations on the Gulf and East Coast.

Navy oil.—One directive calls on four companies to supply 2,100,000 bbl. of Navy special fuel over the next 3 months; the other calls on 14 companies to supply Grade C fuel oil to the primary suppliers on a pro rata basis to make up deficits caused by the diversion of production to Navy special.

The Navy's fuel deficiency has been caused by several factors. It was explained by Deputy Petroleum Administrator Bruce K. Brown. Among

WATCHING WASHINGTON

Bertram F. Linz

Example of Red Tape

Want to make a mountain out of a mole hill?

Oil companies doing business with the military have from time to time complained of the rigmarole involved in contracts and Congress has complained of the red tape which often makes the cost of processing purchases many times greater than the cost of the purchase itself.

Nobody seems to have done anything about it, but when the U. S. Chamber of Commerce got a good example of bureaucracy's Alice-in-Wonderland "efficiency" it decided to let the people see where their tax money was going.

Here's what happened when the Air Force made a big purchase of one copy of a chamber booklet—price 50 cents. That was the mole hill.

The order was mimeographed in its entirety, rather than typed, an Air Force spokesman explaining this was because so many copies of each order had to be made.

Accompanying the order was a four-page contract, dealing with nondiscrimination in employment, patent infringements, the "Buy American" act, inspection and tests, destruction of samples, assignment of claims, and the 8-hour law of 1912.

There was also a four-page set of Additional General Provisions, including clauses on contract termination, patent indemnity, notice to the Government of labor disputes, and the loading, bracing, and blocking of freight cars, plus another page of additional Additional General Provisions on renegotiation and variation in quantity.

And a pink note labeled "Caution-Important," pointing out that "Par. 4 of general provisions does not carry a 10 per cent variation in quantity" and conflicting with paragraph 31 of the additional additional provisions which stated that a 10 per cent variation in quantity will be accepted.

The order was numbered (01-600) 52-2274, based on requisition number LB-52-107, to be paid for from Allotment No. 5723400 266-1443 P443-09 SO1-605, and the shipment was to be marked AF 1799 L (01600) 52-2274.

Fearful it would be engulfed in a million dollars worth of red tape the chamber shipped the booklet, without variation in quantity, properly loaded, blocked, and braced on a freight car—without charge.

And there you have your mountain.

Sulfur Order Near

Moving to overcome the growing shortage of sulfur, estimated at 106,750 long tons for the quarter just starting, the National Production Authority is preparing to issue an order cutting permissible inventories from 90 to 25 days' supply and will follow up with a reduction, probably from 100 to 85 per cent of 1950, in permissible consumption by most industries. The export quota also will be reduced, probably by 20,000 tons.

The cut in inventories will release about 75,000 tons of sulfur, but is a "one shot" proposition. The reduction in consumption will release about the same amount, but probably not before the first quarter of 1952.

Although new sulfur domes have been discovered in this country and Mexico and plants are being built for the recovery of 253,000 long tons a year from sour gas, no substantial increase in supply is expected before the end of 1952.

To encourage the recovery of sulfur, NPA plans to permit refiners and others to use such sulfur themselves up to the extent of 50 per cent of their permissible use.

Super Priority Rating

Indications that mobilization planning may be tending toward a multiband priorities system are seen in the recent adoption of a DX super-priority rating for materials not covered by the Controlled-Materials Plan, for use on top military projects.

Under a system of graduated priorities, used during the last war, top ratings would be given on materials for the most vital projects and lower ratings would be provided for other projects in the order of their importance.

Mobilization officials had hoped to avoid an elaborate priorities system under which each application for materials would have to be classified as to importance. However, difficulties are being encountered in the operation of the Controlled-Materials Plan with steel mills rejecting many orders because they are booked to the limit. There is reason to believe a similar situation exists with respect to some materials not under CMP.

these, he said, are the general scarcity of residual in this country because it is more profitable for refiners to manufacture gasoline and burning oil; recent increases in residual requirements by industry and marine transportation, and the shut down of the Abadan refinery which had been producing 240,000 bbl. of residual daily.

Brown said the directives are subject to price negotiations "mutually satisfactory" to the Armed Services Petroleum Purchasing Agency and the sellers to cover any increase in cost of production of Navy special, and PAD is ready to help both sides to arrive at a fair and reasonable price.

Armed with the authority to regulate distribution, PAD will be able to step in in the event of supply emergencies and by directives make it possible for the companies to take actions which might otherwise be in violation of the antitrust laws or to modify their distribution patterns in such way as to meet a supply deficiency in a particular area.

Lease Clash

Government, lease holders argue over rentals setup

WASHINGTON.—Government officials and lease holders on public lands in the western states clashed this week over whether the waiver of second- and third-year rentals was an incentive to rapid development of oil and gas resources.

Testifying before a House interior subcommittee on legislation introduced by Rep. Kin Regan of Texas to amend the Mineral Leasing Act to eliminate the waiver, Interior Department officials expressed the view that it had not served to encourage the development of the federal lands but on the contrary made it easier for persons taking leases on speculation to sit back and wait for some oil company to buy up their leases.

The waiver of second- and third-year rentals—25 cents an acre annually— was adopted in 1940 to ease the transition between the old prospecting permits for which no rental was charged and the present lease system calling for a rental of 50 cents an acre for the first year and 25 cents annually for the succeeding 4 years.

As a result, it was pointed out by Jacob N. Wasserman, chief counsel of the Bureau of Land Management, lease holders can get control of unproved lands for 3 years at a rental of 16⅔ cents an acre annually. None of the states or private holders make leases on such generous terms, he said.

Revenue loss. — Wasserman testified that noncompetitive leases carrying the waiver are being issued at the rate of 14,000 a year. Since rentals

are waived for 2 years the loss in revenue runs about $7,500,000 annually.

The states and the reclamation fund are the main losers under the present system, Wasserman said. The Government loses little, he explained, because only 10 per cent of the revenue goes into the Treasury; the remainder is split between the states in which the lands are located and the reclamation fund, 37½ per cent to the former and 52½ per cent to the latter.

Oil companies which operate on the public lands are not concerned over rentals since they endeavor to develop production as quickly as possible, H. G. Duncan, chief of the conservation branch of the Geological Survey, said. The chief beneficiaries, he said, are speculators who make up blocks by leases from the federal Government and, where necessary, the states and private owners for disposal to oil operators.

Too expensive. — Spokesmen for individuals holding leases opposed the legislation on the ground it would retard development by making it too expensive for them to hold the lands. Witnesses before the subcommittee contended that the waiver was an incentive to development by encouraging them to search for and block out likely prospects for oil and gas production. It was generally admitted, however, that neither the states nor private owners had ever shown any disposition to waive rentals.

FPC Won't Change Decision

WASHINGTON.—The Federal Power Commission is sticking fast to its August 22 decision that Phillips Petroleum Co. does not come under its jurisdiction because of its gas operations.

The commission last week turned down five applications for rehearing filed by the Wisconsin Public Service Commission, Wayne County, Michigan, and the cities of Detroit, Milwaukee, and Kansas City, Mo.

In rejecting the applications, the FPC said no facts or principles of law were represented "which either were not fully considered by the commission before it entered such opinion and order or, having now been considered, justify a reversal or modification of the commission's opinion and order."

Washington Shuffle

WASHINGTON. — Resignations of Frank A. Watts as director of the materials division and Charles E. Webber as director of the natural-gas production and processing division of Petroleum Administration for Defense; and Mon C. Wallgren, chairman of the Federal Power Commission, were announced here last week.

Watts, who returns to his position as general sales manager of Humble Oil & Refining Co. at Houston, will be succeeded by Richard M. Morrison, his deputy since last July. Webber will be succeeded by R. P. Walsh, assistant director since last June, and will return to his position as assistant manager of Sun Oil Co.'s natural-gas department at Philadelphia.

Wallgren's resignation, effective as of October 1, was accepted by the President with "genuine regret." It has been reported that he is considering returning to his home state of Washington. No successor has been named.

Copper, Zinc Quotas Fixed

WASHINGTON. — Copper supplies for the United States during the current quarter will be 333,770 metric tons out of an estimated world supply of 677,160 tons. Zinc supplies will be 228,460 metric tons out of a world supply of 469,260 tons.

These quotas have been fixed by a 12-nation International Materials Conference which has undertaken control of world supplies of the two metals because of a steadily tightening situation in which it is estimated that production during the present quarter will be short of demand by approximately 100,000 metric tons of each.

Allocations of the two metals were made for each of 36 countries outside the orbit of soviet Russia but including Yugoslavia and are the amount of primary metal which may be processed or consumed by the country concerned, either from domestic production or imports.

In calculating the allocations the committee used consumption in 1950 as a basis. Requirements for direct defense were given priority and some provision was made for requirements for strategic stockpiling. The remainder was allocated for essential civilian consumption, but so that current supplies of copper and zinc may be used to the best advantage, the committee recommended that the several countries adopt measures to eliminate unessential consumption and encourage substitution of materials not in short supply.

GULF COAST

Refinery Expansion Planned

BATON ROUGE, La.—Esso Standard Oil Co. this week revealed that it will embark on a $35,000,000 expansion program at its refinery here, which will raise its capacity from 240,000 to 270,000 bbl. daily.

The project includes major expansion of chemical operations, including expansion of light-ends processing facilities for production of alcohols, butadiene, benzene, and other petrochemicals.

Blending and shipping facilities for gasoline, kerosine, and heating oil also will be expanded.

New units to be constructed include crude distillation, fluid catalytic cracking, and fluid hydroforming.

Construction is due to begin immediately, and completion of the entire project is expected in about 2 years.

Industry Briefs

NEW YORK. — Esso Standard Oil Co. is planning a suburban retreat for its New York headquarters as insurance against a possible atomic attack. In the first such oil-company announcement, Esso Standard said it has contracted to buy a 50-acre site 35 miles west of Central New York City in Morris County, New Jersey. The location will provide emergency headquarters for Standard Oil Co. (N. J.), Creole Petroleum Corp., Esso Export Corp., and Standard Oil Development Co. as well as Esso Standard.

BISMARCK, N. D.—The North Dakota Independent Producers and Royalty Owners Association has filed articles of incorporation with the secretary of state as a nonprofit organization supported by the membership. Incorporators are A. M. Fruh, president; Lars Kleppe, and L. S. Helgeson, all of Bismarck.

TULSA.—Warren Petroleum Corp. has made arrangements to acquire the 25 per cent interest in common stock of Devonian Co., now held by Gulf Oil Corp. The transaction will make Devonian a wholly owned Warren subsidiary and permit the firm to acquire organization and personnel of Devonian, integrated into the Warren organization.

WASHINGTON. — Rep. Robert Crosser of Ohio is planning another visit to Mexico by members of his House interstate commerce committee shortly after the adjournment of Congress, which will probably come late this month. An invitation to make the trip has been extended by President Aleman, it is understood, and members of the committee are desirous of seeing what the Mexican oil industry has accomplished since they last visited the country.

NEW YORK.—Dr. James Boyd, director of the U. S. Bureau of Mines, Washington, will resign that position to join Kennecott Copper Corp. in an executive capacity, the copper company announced here. Boyd declined comment in Washington pending an announcement from the White House.

MIDDLE EAST

Showdown in Iran

Abadan seized; British ask UN to call on Iran to abide by recommendation of International Court of Justice

Ted Armstrong

THE showdown in the drawn-out Iranian drama was at hand this week. The scene had shifted to New York, where Britain asked the United Nations Security Council to call on Iran to abide by the recent recommendation of the International Court of Justice in The Hague.

This recommendation was that no irrevocable action be taken by either Britain or Iran pending a final decision on the merits of the dispute.

Iran has maintained all along that the court did not have jurisdiction in the case, that the dispute was not between the two countries but was an internal problem to be settled by the Iranian Government and Anglo-Iranian Oil Co., Ltd. Iranian Premier Mohammed Mossadegh already has announced he would fly to New York to present his government's views if the Security Council should rule itself competent to hear the dispute.

The Iranians, themselves, set the stage for the crisis by ordering all British technicians out of the country by October 4 and then, in a predawn coup, locking them out of the sprawling Abadan refinery.

What the ultimate outcome would be was not certain, but in any event it seemed apparent that Iranian oil would be a minor factor in the world petroleum-supply picture for months to come.

Opinion divided. — Opinion of industry observers was sharply divided over the question of the use of force by Britain to hold the Abadan refinery, the ability to reach any kind of a compromise with the Iranians, or the possible development of a bond between Iran and Russia.

Basically it was a question of whether economics or nationalism would in the end determine the actions of the Iranian Government. On one hand it was pointed out that, without any oil revenue, the nation would soon be poverty-stricken with a probable resulting fall of the government, but on the other was the obvious popular desire to rid the country of the British regardless of the consequences.

There was a growing feeling that even if the Iranian Government should decide to compromise, the nationalistic feeling which has swept the country might prove so strong among the masses that it would be impossible for the government to accept an arrangement providing for continued British participation in the oil industry.

The developments. — Premier Mossadegh started the ball rolling last week by ordering the last 300 British technicians at Abadan to leave the country before October 4.

The next day Iranian soldiers in a swift move took over the refinery and met British workers with fixed bayonets when the technicians appeared for work.

To guarantee that the British would leave upon expiration of the ultimatum, the Iranians said that company housing would be taken over by the government in cases where the technicians "refused to cooperate" with the oil company set up by the Iranian Government.

Further, the Iranians warned that the Abadan refinery would be destroyed if the British should attempt to seize the refinery. Kazem Hassibi, a leading figure in the nationalization move, said: "With the first British soldier to set foot on Iran's soil, the refinery will go sky high."

Even as the Security Council began discussions October 1 on the dispute, Anglo-Iranian announced it would evacuate the more than 300 remaining technicians from Abadan.

The company said the refinery personnel would leave on the cruiser Mauritius and accompanying destroyers October 3, going to Basrah, Iraq, and then to England.

The huge refinery, already in the hands of the Iranian Army, was classified by the government as a "military area" and therefore "prohibited to foreigners."

Prime Minister Clement Attlee of Britain immediately sent a personal message to President Truman saying the British Government would welcome anything the United States might do to solve the crisis but making no recommendations.

Truman's reply was not made public, but at the same time the President asked Iran to cancel its announced to eject British workers.

The U. S. State Department said in an announcement that the United States "has emphasized to both the Iranian Government and the British Government that it stands ready to render any assistance that it can in helping them to find a settlement of this difficult problem."

American view.—Policy of the United States in the crisis was expected to be this: That this country would continue to urge a calm approach by both sides with the hope that the problem still could be mediated.

In London it was reported that Truman's note strongly opposed the use of force by the British to maintain its oil technicians in Iran, but neither did it suggest that the technicians be withdrawn. London dispatches said the British felt that the United States could not back them in the use of force in Iran.

The British position was under continuous discussion by the Cabinet. It was that Britain would stand firm in Iran, hoping that American intervention might soften the Iranian attitude and result in a cancellation of the order ejecting Abadan refinery personnel.

Whether the two countries could be brought together again over a conference table remained a question.

Mossadegh's assistant, Huessin Fatemi, already had announced: "I do not think Iran will make any new endeavor to resume talks with the British." He said the order ousting the British "will end the present state of confusion and uncertainty and will clarify the situation."

At the height of the controversy, Anglo-Iranian Oil Co., Ltd., published a press release strongly condemning "current Persian Government propaganda" against the company.

It strongly denied, specifically, that the company had disregarded the growth of nationalism in Iran and was slow to adjust the terms of its concession agreement, that it had used political interference and economic pressure in its relations with Iran, and that it had used "bribery and corruption" to further its interests.

Situation in Iran.—Opposition to the Iranian Government's handling of the dispute disappeared in Teheran, at least temporarily, following Mossadegh's announcement he would fly to New York to appear before the UN Security Council. Twelve opposition deputies signed a letter saying they would cease to oppose the government until the British complaint had been disposed of.

Earlier they had boycotted five consecutive meetings of the Majlis, the lower house, and for 3 weeks had prevented Mossadegh from obtaining a vote of confidence.

Talk was growing of a swing toward the Soviet Union, and a Teheran newspaper reported the signing of an interim barter agreement under which the Russians would supply 12,000 tons of sugar in exchange for wool and almonds.

In another development the Governor of Azerbaijan was removed by Mossadegh, presumably because of

his vociferous opposition to the government in recent weeks.

From Pakistan came an official denial from the government that Pakistan had been negotiating with Iran for petroleum products since the shutdown of the Abadan refinery.

There have been several reports in recent weeks of sales of products and crude by the Iranian Government, but as yet there has been no report of actual shipment.

"Queen Mary" on Location

The "Queen Mary," the largest and most complete drilling barge in the world, is now on location in the Persian Gulf to drill Arabian American Oil Co.'s second offshore well.

Safaniya 3 will be drilled by Aramco using the 1,800-ton barge, which the company bought from Creole Petroleum Corp. for $750,000 and towed to the Middle East from Venezuela.

The discovery well, Safaniya 1, 13 miles south of Ras el Misha'ab, found oil in the Bahrein zone. Safaniya 2 was drilled on land.

The huge barge was built for Creole in 1948 at a cost of $1,500,000 but was used to drill only one well, in Lake Maracaibo. It was designed for drilling to a depth of 15,000 ft. (For details on the barge and its 11,000-mile trip to the Persian Gulf, see *The Oil and Gas Journal, August 2, 1951, page 48.*)

Iraq Refinery Talks Resume

Four-year-old talks concerning construction of a refinery in Iraq were under way again last week in London.

General Nuri Es Said Pasha, Iraqi premier, called on officials of Iraq Petroleum Co., Ltd., and a British refinery-construction firm to discuss plans for the refinery.

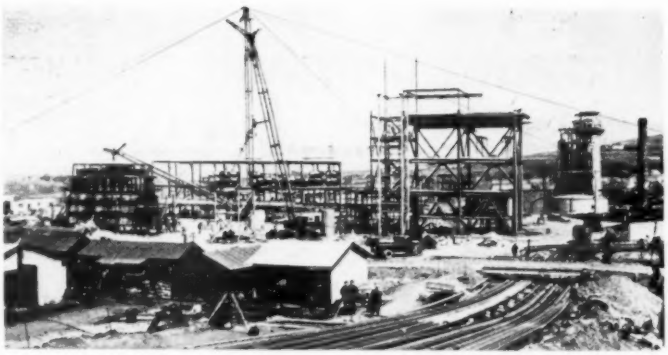
For several years the Iraqis have been planning construction of a refinery sufficiently large to meet domestic product requirements.

Early this year the government announced a new law which would permit the Ministry of Economics to build the refinery. A few months before the National Bank of Iraq had agreed to provide about $5,600,000 for the project provided the government would put up the balance of $11,000,000 to $14,000,000.

As planned earlier this year, the refinery would have a capacity of about 24,000 bbl. per day and would operate on royalty crude received from Iraq Petroleum.

Until recently, Iraq's domestic needs were met with products from the Abadan, Iran, refinery and from the 8 000-bbl. topping unit of Khanaqin Oil Co., Ltd. (Anglo-Iranian), at Alwand.

EUROPE



ADDED CAPACITY.—Construction work on the 10,000-bbl. fluid catalytic cracking unit at the Llandarcy refinery of Anglo-Iranian. The new unit, being erected by M. W. Kellogg Co., is expected to be on stream by next September.

Llandarcy Expansion

Added refining facilities to be ready by mid-1952

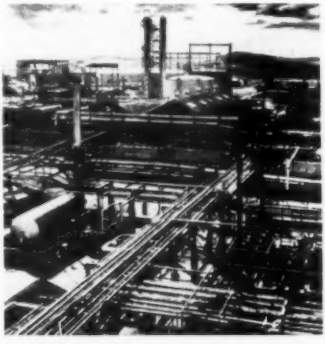
THE Llandarcy, Wales, refinery of Anglo-Iranian Oil Co., Ltd., won't be finished for another year, but it already is processing 15,000 bbl. of crude daily more than its ultimate rated capacity.

By the time it is finished, if the emergency caused by nationalization in Iran still exists, it will be operating at twice its designed capacity.

By sacrificing quality for quantity, the company now is processing about 65,000 bbl. of crude per day and expects to reach a 100,000 bbl. per day rate by the middle of next year.

The refinery is designed, when complete, to operate at a crude-throughput rate of 50,000 bbl. per day.

Now under construction are a fluid catalytic cracking unit, vacuum distillation unit, kerosine-extraction facilities, a rerun unit, and other facilities. Completion of construction is expected late next year.



PRESENT PLANT.—This is the crude-distillation area of Anglo-Iranian's Llandarcy refinery, now undergoing a large expansion.

The existing thermal cracking unit, along with other facilities, has been converted to crude distillation. If the emergency still exists when the vacuum distillation is completed in mid-1952, it also will be used for crude-distillation purposes. The company plans to manufacture no lubricating oils and no high-octane gasoline during the present product shortage resulting from the Iranian crisis.

Original plant.—The original Llandarcy refinery was built largely during World War I and completed in 1922 by National Oil Refineries, Ltd., a wholly owned subsidiary of Anglo-Iranian. Until World War II it had a capacity of about 7,000 bbl. per day.

The refinery was expanded by addition of a 45,000-bbl. crude unit and stabilizer plant, completed in 1949 as the first major refinery unit to be finished in England after World War II.

The present construction represents another long-planned expansion of the refinery.

New jetties.—In addition to process facilities, the present program involves replacement of five timber jetties designed to handle 10,000-ton tankers with steel and concrete structures to handle tankers of the 28,000-ton class. Three have now been completed and the remaining two are under construction.

Tankage also is being increased. The main tank farm, when finished, will contain 90 tanks with a storage capacity of 5,000,000 bbl. Six steam-coiled tanks with an aggregate capacity of 75,000 bbl. have been erected near the pier area to handle heavy-crude shipments.

LATIN AMERICA

Congress a Success

First Venezuelan national petroleum convention results in better relationship among companies, other countries

Oscar B. Irizarry

Dr. Irizarry has just returned from Caracas where he covered the National Petroleum Convention for The Oil and Gas Journal and its companion publication, Petroleo Interamericano. He gives here his commentary on the high spots of the gathering.

NOW that 3 weeks have elapsed since the Venezuelan Government brought to an end the 10-day session of its first national petroleum convention, the results obtained are clearer.

The event was a success. From the standpoint of the material reviewed, the international character of the audience, the planning that went into its organization, and the expeditiousness with which it was conducted, the convention ranks among the best oil gatherings held since the end of World War II. The importance of the oil personalities in attendance and the fact that the number of delegates and guests was limited to approximately 400 by formal invitations, made it possible for those personalities and the key operating men of the Venezuelan industry to meet each other personally, mingle freely, and exchange ideas and impressions in a spirit of friendship and informality. In this respect, many visitors found it more desirable than the recent World Congress at The Hague.

DR. O. B. IRIZARRY

Better relations.—Three important attainments are now evident. One is the fact that Venezuela has strengthened its relations with other oil-producing countries in the world. By acquainting foreign visitors with the achievements of the industry under private management with government cooperation, it has impressed them with the importance of the nation as an oil producer. The addresses by Santiago Vera, the nation's minister of mines and hydrocarbons; Luis E. Gomez Ruiz, minister of foreign relations; Oscar Chapman, Secretary of the Interior of the United States; and Eric A. Berthoud, assistant undersecretary at the British Foreign Office, did much to strengthen those friendly relations.

Wealth of information.—Another important attainment has been the effectiveness with which the government and the oil companies have made available to the Venezuelan public and foreign nations a wealth of basic information about the industry in Venezuela. Heretofore that information was found only in widely scattered publications and in company files. The convention made it available in two well-organized volumes in the Spanish and English languages. Requests for these books continue to reach the Ministry of Mines and Hydrocarbons from all parts of the world.

Intercompany cooperation.—The third direct result of the meeting has been the furthering of intercompany relations in the country, as well as company-government relations. By cooperating with one another in the preparation of the papers and by working in joint committees in the planning of the program, the personnel of the various companies, and the government agencies have become better acquainted and better informed about each other's activities.

EUROPE

Peat Eyed as Gasoline Source

Preliminary studies are being made by the Bureau of Mines in Washington to determine the feasibility of producing gasoline and chemicals from Irish peat.

The results of these studies will be the determining factor on which the Economic Cooperation Administration will pass on a project submitted by the Government of Eire for research on the synthesis of peat with a view to establishing a new industry to meet Eire's needs for motor fuel and fertilizers.

The project would be financed in part by ECA under the technical assistance program but since it is now "in the works" and its future uncertain officials declined to release information regarding the financial and other details.

Reports from Dublin indicate that experimentation already is going on, with American, British, and continental firms participating. ECA officials, however, expressed doubt that any American oil companies are working in that field or will get into it if the project is approved. More likely, they said, American technical assistance will be provided through the Bureau of Mines.

An ECA-supported project for the improvement of methods of harvesting, drying and utilizing Irish peat already is under way. The Dublin reports cited experiments by a German firm which led to estimates that approximately 1,500,000 bbl. of motor fuel could be secured from 450,000 tons of Irish peat, meeting about one-seventh of Eire's annual requirements.

ASIA

Pakistan Survey Begins

A 73,000-sq. mile airborne-magnetomer survey in Pakistan and India was begun this week by Standard-Vacuum Oil Co.

The first magnetic survey to be conducted by air in Asia, the project will seek magnetic data on rock conditions in the vast alleuvial plain of the Bengal basin, which includes the Ganges River delta at the head of the Bay of Bengal.

Standard-Vacuum said the survey will take 4 months and will be conducted for the company by Fairchild Aerial Service, Inc., a Gulf Oil Corp. licensee. Base of operations for the project is Dum Dum Airdome at Calcutta, where laboratory facilities have been established. The project in eastern India and eastern Pakistan represents the first use of the airborne magnetometer by Standard-Vacuum's exploration staff, the company said.

The company flatly denied press reports from Pakistan saying the firm had been granted drilling rights in the area. While it appeared that discussions had been held on the subject of concessions, no permits have been granted for oil operations except the airborne survey. Standard-Vacuum also said it has no plans at present for an aerial survey in West Pakistan, as reported in that country.

The company's principal crude-oil production at present is in Indonesia, but it has been a marketer in India since the 1890's.

Two British companies, Burmah Oil Co., Ltd., and Attock Oil Co. now operate in Pakistan. Current production in Pakistan is about 3,000 bbl. per day.

Burmese Granted Loan

Britain has offered to lend the Burmese Government $7,000,000 with which to buy an interest in the Burma operations of Burmah Oil Co., Ltd. The amount was half that requested by Burma.

The British foreign office said that the loan is contingent upon the negotiation of a mutually acceptable agreement between the oil company and the Government of Burma.

Offer of the loan followed several months of negotiations.

PERSONALS

Pipe-Line Builder

Trans-Northern head has had distinguished career

ALBERT N. HORNE, president of the new Trans-Northern Pipe Line Co., is preparing for construction of Canada's longest product-pipe-line system. This is another milestone in his distinguished career of managing the laying of some of the largest petroleum pipe-line undertakings of the industry.

Born in Matherville, Miss., he graduated from Mississippi State College (then Mississippi A. & M.) with a degree of bachelor of science in electrical engineering. Following service as lieutenant in the Army tank corp, he joined the Doherty organization and rose to become manager of Empire Pipe Line Co., vice president of Texas-Empire Pipe Line Co., and Kaw Pipe Line Co., and director of Texas-New Mexico Pipe Line Co.

In World War II Horne was called from service as a major, attached to the General Staff of the Army, to become vice president and assistant general manager of War Emergency Pipelines, Inc. Later he succeeded B. E. Hull as general manager during final construction and operation of Big Inch and Little Big Inch.

He directed construction of the Basin Pipe Line System from Jal, N. M., to Cushing, Okla., in 1948 and 1949.

In July 1949, Horne again became associated with B. E. Hull as vice president and general manager of Trans-Arabian Pipe Line Co. Horne went to Beirut, Lebanon, to direct construction and early operation of the 1,068-mile, Persian Gulf-Mediterranean line successfully completed ahead of schedule last year.

He was elected president of Trans-Northern Pipe Line Co. in June 1951 with headquarters at Toronto, Ont., where he is directing preparations for building the company's products line from Montreal, Que., to Hamilton, Ont.

James M. Gibson, assistant superintendent for Sohio Petroleum Co. at Russell, Kans., has been transferred to Shreveport and promoted to superintendent.

E. A. Robb, tool pusher for Pioneer Drilling Co., has joined Marsh & Pursel Drilling Co. at Casper, Wyo., in the same capacity.

Clarence O. Magee, associate gas engineer for Humble Oil & Refining Co. at Katy, Tex., has been transferred to Raymondville, Tex., and promoted to production engineer. **Edwin E. Byrd,** senior engineer at Houston, has been promoted to assistant district superintendent and transferred to Winters, Tex.; and **Virgil H. Jones,** farm boss at Gladewater, Tex., has been transferred to Pickton, Tex., and promoted to assistant superintendent.

Paul P. Swift, reservoir engineer for Pure Oil Co. at Crystal Lake, Ill., has resigned and joined Deep Rock Oil Corp. at Wichita Falls, Tex., as production engineer.

Edgar E. Martin has joined the Edwin W. Pauley organization as district geologist of the northeastern Mexico division with headquarters at Reynosa, Mexico. For the past 5 years Martin has been an independent operator at Ardmore, Okla., and prior to that he served 8 years as geologist for Sun Oil Co.

William C. Byrd, geological engineer for Sunray Oil Corp., has been transferred from Lewisville, Ark., to Corpus Christi, Tex.

W. E. Hopkins, Jr., technologist for Shell Oil Co., has been transferred from the Houston refinery to New York City.

L. D. Wooddy, Jr., associate petroleum engineer for Humble Oil & Refining Co., has been transferred from Genoa to Kingsville, Tex., and promoted to district reservoir engineer.

Albert S. Orr, director of the refinery-technology laboratory for Gulf Oil Corp. at Philadelphia, has been transferred to Pittsburgh and promoted to assistant manager of the technical division in the manufacturing department.

A. L. Kraft, formerly district superintendent for The Texas Co. at Salem, Ill., has joined Fox-Fox Oil Co. at Carmi, Ill., as general superintendent.

Harry Goodin, party chief for Amerada Petroleum Corp., has been transferred from Floydada to Midland, Tex.

Harold E. Aab, production foreman for Skelly Oil Co. at Oklahoma City, has been transferred to Lindsay, Okla., in the same capacity.

C. H. JOHNSON

Curtis H. Johnson has been promoted to the newly created post of assistant chief geophysicist in the exploration department of the General Petroleum Corp. Formerly senior geophysicist for the firm, Johnson will continue to make his headquarters in the company's Los Angeles office. He has been with the firm since 1939, and is currently vice president of the Society of Exploration Geophysicists.

C. M. Boles, assistant district superintendent for Phillips Petroleum Co. at Odessa, Tex., has been transferred to Big Spring, Tex., and promoted to district production superintendent.

R. B. Cowart, assistant district petroleum engineer for Humble Oil & Refining Co. at Hobbs, N. M., has been transferred to Midland, Tex., as production engineer.

Addison L. Hayner, division geologist for Standard Oil Co. of Texas at Eldorado, Tex., has been transferred to Iraan, Tex., and promoted to district development geologist for the Pecos district.

John H. Osborne, Jr., party manager for Stanolind Oil & Gas Co. at Brownfield, Tex., has been transferred to Levelland, Tex., in the same capacity.

J. M. McLaughlin, production superintendent for Magnolia Petroleum Co. at Snyder, Tex., has been transferred to Brownfield, Tex., as assistant superintendent.

J. W. Workman, assistant plant superintendent for Humble Oil & Refining Co. at Katy, Tex., has been transferred to the Trawick Gas system at Cushing, Tex., as superintendent.

PERSONALS

W. M. OSBORN

W. M. Osborn has been named vice president and general manager of the El Capitan Oil Co., Midland, Tex. Others added to the firm's staff include: **Lyle Brush,** who will manage exploration department; **R. C. Senning,** who is production geologist; and **Dave Morrison,** who has joined as petroleum engineer. Before joining the firm, Osborn was with Western Co. of Midland for 8 years as manager of the geological and chemical-engineering department. In his new capacity he will be in charge of all the firm's operations, including exploration and production.

W. H. Cooper, technologist for Shell Oil Co. at Houston, has been transferred to New York.

Julian C. Ashby, party chief for Atlantic Refining Co., has been transferred from Baton Rouge to De-Ridder, La.

J. P. Everett, formerly instructor at Oklahoma A. & M. College, has joined University of Kansas faculty as an instructor in the department of petroleum engineering.

J. W. Williams, drilling superintendent for Falcon-Seaboard Drilling Co., has been transferred from Hempstead, Tex., to Conroe, Tex.

Ples Bice, production foreman for Skelly Oil Co., has been transferred from Penwell to Morton, Tex., in the same capacity.

R. G. Sohlberg, formerly with Standard Oil Co. of California, has joined United Geophysical Co. of Canada as manager, with headquarters at Calgary, Alta.

D. S. Simmons, formerly manager of the engineering division for Imperial Oil Co., Ltd., at Sarnia, Ont., Canada, has been appointed general superintendent at Montreal East refinery, and **R. W. Dunlop** has been appointed manager of the engineering division succeeding Simmons. Simmons joined Imperial in 1932, was loaned to St. Clair Processing Corp. from 1943 to 1946, and was appointed manager of the engineering division in 1950. Dunlop joined Imperial in 1927, was on loan to St. Clair from 1944 to 1946, and was appointed assistant manager for Imperial in 1950. **C. P. Warkentin** and **J. J. Rowan** succeeded him as assistant managers of the division.

Gordon R. Stine, formerly of Gordon & Stine, oil producers, has opened petroleum-engineering offices at Wichita Falls, Tex.

J. O. Hendricks, tool pusher for McConnell Drilling Corp., has been transferred from Farmington, N. M., to Clear Creek, Utah.

Louis E. Reynolds, maintenance foreman for Atlantic Refining Co. at Merryville, La., has been transferred to Crane, Tex., and promoted to plant superintendent.

J. M. Tharp has been transferred from Tide Water Associated Oil Co.'s Tulsa office to Houston as Gulf Coast engineer. **Wendell J. Haugh** has been transferred from Eureka, Kans., to Tulsa and promoted to division engineer for the Oklahoma-Kansas division.

George L. Buckles, superintendent for Forest Oil Corp., and **John C. Hostetler,** division engineer for Richardson & Bass, have resigned from their respective companies and announce the formation of Buckles & Hostetler, consulting engineers, with office in

G. L. BUCKLES

J. C. HOSTETLER

Monahans, Tex. They will specialize in water flooding. Buckles has had 20 years' production experience, having been associated with Pure Oil Co. for 16 years, and Forest Oil Corp. since 1948. Hostetler, who has been active in the Permian basin for 15 years, was with Gulf Oil Corp. for 11½ years and with Richardson & Bass for the past 6 years.

F. W. Stover, compressor-plant foreman for Humble Oil & Refining Co. at Stratton, Tex., has been transferred to Genoa, Tex., and promoted to gas-plant superintendent.

William E. Handley, pipe-line superintendent for Trans-Penn Transit Corp., has been transferred from Olean, N. Y., to Emporium, Pa.

Hugh H. Cuthrell has been elected president of Brooklyn Union Gas Co. to succeed **Clifford E. Paige,** who will become chairman of the board. Cuthrell, who was 1949-50 president of American Gas Association, also will serve as a director and member of the executive committee. In these positions he will replace **Benjamin G. Neilson,** who will retire soon. Cuthrell, who has been with Brooklyn Union 24 years, was vice president until his election to the presidency.

C. A. Brooks, area geologist; **A. D. Campbell,** senior landman; and **D. D. Windfield,** geologist with Stanolind Oil & Gas Co., have been transferred from Lake Charles, La., to New Orleans and will be in charge of the firm's newly created office there.

Robert B. Curran has been named president and managing director of Home Oil Co., Ltd., a Canadian firm with headquarters in Calgary, Alta., Canada. He formerly was in charge of western producing operations of Imperial Oil, Ltd.

Donald G. Wilde has joined Republic Natural Gas Co. as engineer at Dallas.

R. A. Drake, assistant district superintendent for Amerada Petroleum Corp., has been transferred from Duncan, Okla., to Casper, Wyo.

John Daly, supervisor for the West Texas-New Mexico district for General Geophysical Co., has resigned effective November 1 and will open an office in Midland, Tex., as consulting geophysicist and geologist. Prior to joining General, Daly was associated with Honolulu Oil Corp. in charge of seismograph work, and with Shell Oil Co. as a geologist and seismologist.

Mervin Henderson, engineer for Ajax Pipe Line Corp. at Springfield, Mo., is on loan to Lakehead Pipe Line Co. at Superior, Wis., as construction engineer.

Richard L. Hocker, petroleum engineer for Amerada Petroleum Corp., has been transferred from Fairbanks, Tex., to Tulsa.

James M. Gaffney, tool pusher for Lowell & Gist Drilling Co., has been transferred from Manderson to Gooseberry, Wyo.

Elmo L. Walling, petroleum engineer for Humble Oil & Refining Co., has been transferred from Midland to Denver City, Tex., and promoted to district petroleum engineer. **Joe E. Graham,** senior petroleum engineer at

PERSONALS

A.A.O.D.C. OFFICERS.—Officers elected at the annual meeting of the American Association of Oilwell Drilling Contractors in Fort Worth are, front row, left to right: Earle C. Flesher, Johnson & Flesher Drilling Co., Oklahoma City, vice president for Central Mid-Continent; Joseph V. Dunbar, Dunbar Drilling Co., Salem, Ill., vice president-at-large; A. W. Thompson, Thompson-Carr, Inc., Houston, president; Brad Mills, A.A.O.D.C., Dallas, executive vice president; Marion S. Church, Dallas, general counsel; Louis A. Beecherl, McDaniel & Beecherl, Dallas, treasurer. Back row, left to right: A. H. Bell, Bell & Burden, Inc., Los Angeles, vice president for California; H. H. Hillman, California Production Service Co., Long Beach, vice president for well servicing; E. K. Carey, E. K. Carey Drilling Co., Inc., Denver, vice president for Rocky Mountains; J. U. Teague, Columbia Drilling Co., Houston, vice president for Gulf Coast; N. H. Wheless, Jr., Wheless Drilling Co., Shreveport, vice president for Cretaceous and Tertiary basins; Harold M. McClure, Jr., McClure Drilling Co., Alma, Mich., vice president for cable tools; R. S. Makin, Makin Drilling Co., Hobbs, N. M., vice president for West Texas and New Mexico; and J. Doyle Settle, A.A.O.D.C., Dallas, secretary. Thomas S. Doran, Vandalia, Ill., vice president for Illinois, Michigan, Indiana, and Kentucky, is not shown.

New Orleans, has been transferred to Midland, Tex., and **J. T. Knaugh,** assistant superintendent at Friendswood, Tex., has been transferred to Beaumont, Tex.

Lloyd Burson, tool pusher for Wheless Drilling Co., has been transferred to Houma, La., in the same capacity.

H. L. Lockhart, independent producer, has moved his offices from Colorado City, Tex., to Truth or Consequences, N. M.

William H. Miller, formerly with Pure Oil Co., has been elected vice president of Hughes Oil Co., Chicago.

John H. Bolstad, field petroleum engineer for Continental Oil Co., has been transferred from Ventura, Calif., to Wichita Falls, Tex., in the same capacity.

Verne F. Gaede, petroleum engineer in the oil and gas division of the State of California, has been transferred from Taft to Los Angeles.

Robert N. Sears, who recently returned to Phillips Petroleum Co. after being on loan to the Petroleum Administration for Defense, has been appointed assistant to the executive staff of the company and will handle special duties. He was president of Wasatch Oil Co. when it was purchased in 1947 by Phillips.

DEATHS

Moreton Reginald Thompson, 74, retired vice president of Southern Counties Gas Co., died at Santa Monica, Calif., September 26. He was affiliated with the gas company for 30 years, and retired in 1941.

William H. Conklin, one of the founders of Bishop-Conklin Co., Los Angeles, died September 25 at Winnemucca, Nev.

Justin W. Meek, 78, petroleum engineer at Los Angeles for the past 40 years, died September 27.

Nap P. Strickland, 58, production clerk with Pacific Western Oil Co. for 25 years, died September 24 at Long Beach, Calif.

Barnett Alfred Joslin, 68, Los Angeles mining engineer and former secretary of the Southern California chapter, A.I.M.E., died September 20 in Mexico City.

Oscar Marquis, 67, independent oil producer, died recently at Marietta, Ohio.

William D. Forshey, 53, tool dresser on an oil lease at Creston, Ohio, died there recently.

E. J. Evans, 69, president and principal owner of Evans Oil & Gas Co., died September 24 at Paintsville, Ky. He was a director of the Kentucky Oil and Gas Association.

R. F. Baity, 53, vice president in charge of sales for Standard Oil Co. (Ind.), and a director of the firm, died September 30 in Chicago.

William Francis Conry, 78, retired superintendent of the old Prairie Oil & Gas Co., died September 29 in Tulsa.

Henry T. Adams, 57, foreman for Mid-Continent Petroleum Corp., died September 30 in Tulsa.

R. T. Perry, 77, who operated a lease for Selby Oil & Gas Co. near Sperry, Okla., until retiring 8 years ago, died there September 28.

Glen C. Fenton, 46, Grayling, Mich., a partner and field superintendent for Fenpar Cos., died September 21.

J. C. Bruce, district superintendent for British-American Oil Producing Co. at Oklahoma City, died September 25. He moved to Oklahoma in 1910 as a pipeliner for Gulf Oil Co. He joined B-A in 1935.

Sam H. Vaught, superintendent of the case and packaging division of Sinclair Refining Co., for the past 12 years, died September 23.

fluid transportation

....THE PIPE LINE

THE JOURNAL'S 1951 ANNUAL PIPE-LINE SECTION

Featuring modern pipe-line construction and operation . . . . .

1—CLEARING. After route has been surveyed and right-of-way procured by company, clearing operations are started. This is normally the first job started by the contractor. The operation generally proceeds rapidly.

3—STRINGING. Pipe may often be loaded directly from cars at a railroad siding onto the stringing truck. This photograph shows mill-wrapped pipe being loaded on a stringing truck which operates between job site and storage yard.

2—GRADING. A reasonably smooth, level right-of-way pays big dividends. Pipe-stringing vehicles and other equipment move efficiently over a well-prepared right-of-way.

4—DITCHING. This operation can be a big one, even on smaller-diameter lines. The huge ditcher shown here is equipped with a special device for trimming and padding the ditch.

Why not keep a Photographic Record?

Pipe-laying practices are presented by the author in photographs from petroleum and natural-gas projects

by L. W. Ewing, Jr.

A GOOD photographic record of construction operations has long been recognized as a very valuable asset in industry. Companies place varying amounts of emphasis on the creation of photographic records on their projects, depending on their appreciation of the value that these records may be to them in the future.

5—ROCK EXCAVATION. Making ditch in rocky country is a tedious and expensive operation. Here is shown a crew and some of the equipment used in one phase of a rock-excavation operation.

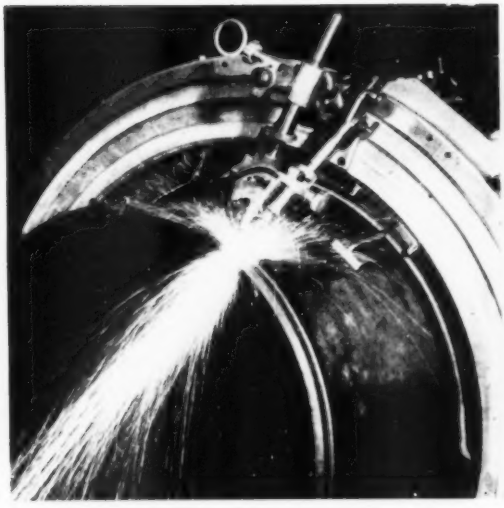
6—BENDING. This is an extremely important operation in pipe-line construction. This photograph shows an unusual 87° bend and the bending machine on which it was formed.

The pipe-line industry is a natural for making maximum use of photography in recording the problems of construction, machinery used in the work, and the degree of excellence provided by the finished job. Since pipe lines are now being built at increased rates of progress and with improved construction machinery, photographs sometimes constitute the only general record of certain phases of the work, other than the routine footage reports filed by job inspectors. Consequently, pipe-line companies are turning more and more to photography as a key supplementary record to their daily reports.

The accompanying representative selection of photographs illustrates the various phases of modern pipe-line construction. The shots have been taken by professional photographers using modern well-selected equipment and it is fairly obvious that the men who have recorded these exposures have considerable skill in dramatizing the business of building a pipe line. Many of the selections now in our files have been acquired for the express purpose of apprising company management of the changing techniques in pipe lining and the varieties of terrain which must be overcome.

THE AUTHOR

L. W. Ewing, Jr., is assistant chief engineer of Standard Oil Co. (Ind.) products pipe-line department. He joined the company in 1948 as senior engineer, and since has engaged in both engineering and operating work on pipe-line installations. He is a graduate of University of New Hampshire.



7—CUTTING AND BEVELING. When pipe ends are damaged in handling, the damaged end is cut off with a beveling machine. This view of a machine in operation shows how the cut is made.

8—DOUBLE JOINTING. Here an automatic welding machine is shown in operation. Manual stringer bead welding preceded final automatic submerged arc welding.

9—LINE UP. The side boom tractors shown here are rigged up with tongs on a single load line. This equipment functions to place and maintain the pipe in alignment for welding.

". . . use photographs as supplementary record to daily reports"

10—LINE UP CLAMP. Seen here emerging from the end of the pipe is an internal line up clamp. This device is employed to provide correct alignment of pipe at the welded joints.

11—WELDING. Progress depends on welding. Here two welders are working on one joint.

12—*LAYING OPERATIONS. This is a view of a typical right-of-way. Welding operations are being carried out on the stream bank and a joint of pipe is being moved ahead for the next operation.*

13—*ROAD CROSSINGS. Pipe-line construction is a fast-moving operation. To maintain schedules, road crossings are normally completed after other operations have moved well ahead.*

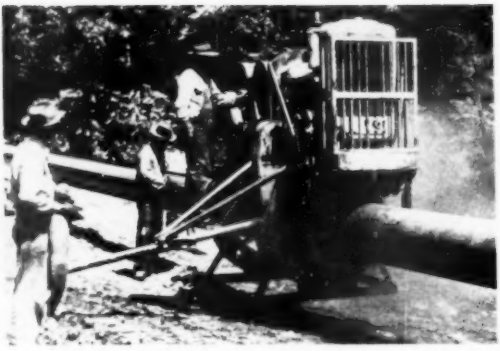
". . . and for instructing engineering and office personnel"

15—*CRADLING. This equipment, a side-boom tractor with a pipe cradle, supports the pipe ahead of the cleaning and coating machines. Provided with rollers, the cradle is moved along the line by the tractor.*

14—*ROAD BORING. This machine is used to make openings under roads. Where rock is present percussion equipment is used.*

16—*WINTER WORK. During cold weather pipe lining requires ingenuity and endurance to produce a satisfactory job. Shown here is just one of the many operations connected with winter operation. Device in foreground heats pipe ahead of cleaning and priming*

17—CLEANING AND PRIMING. A self-contained unit performs this twofold operation. The machine shown here utilizes a large stabilizing wheel.



18—PREPARATION FOR COATING. Removal of dirt and application of priming coat are essential to successful hot-coating operations which follow.

19—COATING REINFORCEMENT. This photograph shows glass wrap being applied to line. Note use of sand bags to pad ditch in this rock-country operation.

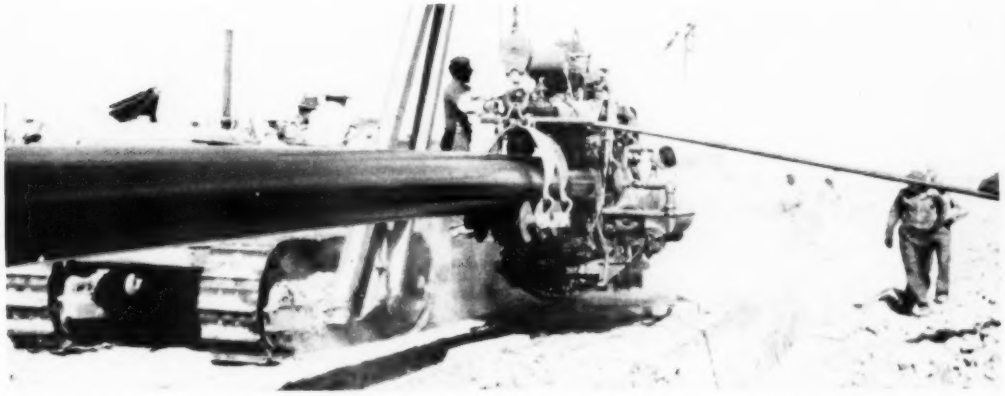
20—DOPE KETTLE. Hot coating is supplied to the coating and wrapping machine by this mobile tank unit. Hot-coating material flows via hose.

21—WRAPPING. Closeup view of the wrapping element of a large coating and wrapping machine. Felt covering is fed out with forward movement of unit.

22—HEAVY EQUIPMENT. This tractor, equipped with extra wide track shoes on trench side, along with other features, is typical of today's heavy pipe-lining equipment.

23—COATING ACROSS WATER. Mobile kettle in background supplies hot coating material to this coating and wrapping machine while operating over a short stretch of water.

24—COATING AND WRAPPING. This view of a coating and wrapping operation shows the machine and its attendant equipment. Note how closely the line follows right-of-way profile.



25—CRADLING DOPE MACHINE. Here a coating and wrapping machine is shown in operation on a big-inch pipe. To provide running clearance for the machine, the pipe is held in an elevated position with a cradle which may be seen just in front of the machine.

Effective protection prolongs life of pipe lines

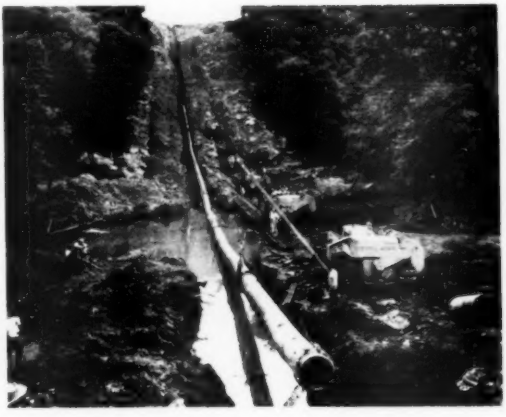
26—HOLIDAY DETECTOR. The device shown here is used to locate flaws in pipe coating.

27 SUPPLEMENTARY SHIELD. In this pipe line construction operation a section of pipe, which has been jacketed with a rock shield, is being "walked" into position.

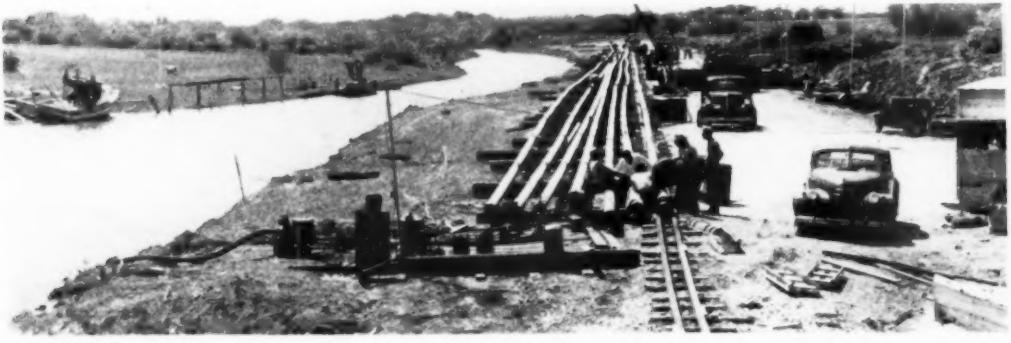
River and submarine crossings require special procedures. Today's pipe liners have the know-how

28—LOWERING IN. Here four tractors are maneuvering the line into position for placing on skids in ditch. After being properly positioned on skids in ditch, the section of line located in the left foreground of the photograph will be aligned on the skids and then the sections will be joined by welding.

29—SHOOTING. Underwater excavation for a rocky river crossing is in progress here. Pipe-line approaches to the crossing may be seen in the foreground.



30—WATER CROSSING. Here a stream-crossing operation is in progress. Final depth and position of the pipe are accurately recorded by a crew of engineers.



31—SUBMARINE LINES. This is a view of a pipe-yard assembly line and launching ways for a submarine construction operation. The pipe section resting on the launching ways is being fitted with drums which provide buoyancy for towing.

The photographs:

Photographs for this section on pipeline construction have been taken by the following organizations. The views furnished are indicated by numbers after each name.

Allis-Chalmers Manufacturing Co.: 1, 13, 16, 24, 26, 30, 32, 33, and 34.

Barrett Division, Allied Chemical & Dye Corp.: 3, 5, 17, 29, and 31.

Caterpillar Tractor Co.: 2, 9, 15, 19, 22, 28, and 35.

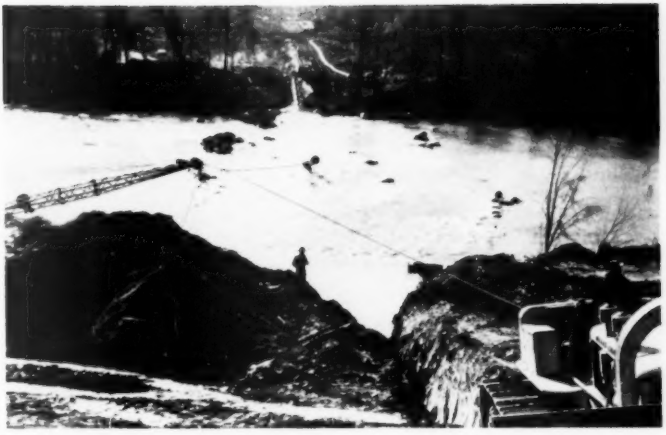
M. J. Crose Manufacturing Co.: 10, 14, 23, and 25.

Crutcher-Rolfs-Cummings, Inc.: 4, 6, 8, and 20.

International Harvester Co.: 12, 27.

Perrault Brothers: 7, 18, and 21.

H. C. Price Co.: 11.



*32—**PULLING A WATER CROSSING.** Tractor in foreground is towing a section of line into position in this view of a river-crossing construction operation. Direction of tow pull is controlled by a crane positioned at left. Only the crane's boom is visible in this photo.*

*33—**STREAMS AND RAILROADS.** The pipe section shown here, when installed in its final position, will be joined with the section located on the hillside, right background.*

*34—**BACKFILLER.** This tractor is rigged up for backfilling operation one of the final phases in pipe-line construction. Machine requires two operators.*

*35 **CLEANUP.** Here final cleanup and grading operations are in progress on a right-of-way through wooded country. Tree trunks, stumps, and other debris are cleared from the right-of-way.*

Ditching machine being assisted by winch line to drum on rear end of tractor while trenching on steep hillside.

Two welders running stringer bead on the right-of-way during pipe-line construction.

PIPE-LINE TECHNIQUES ADVANCE

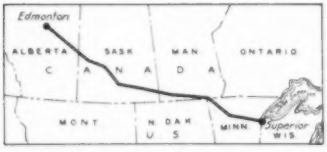
PROGRESS made by the pipe-line industry in recent years has been tremendous and its expansion continues with large new crude and refined products lines being built in many countries throughout the world. The big impetus came in March 1942 when the Special Engineering Committee, working with the Petroleum Administration for War in Washington, had the courage to recommend a 24-in.-diameter line (War Emergency Pipelines Inc.) to move crude oil from Texas to the East Coast refineries when tankers were being submarined off the United States coast. This big crude-oil line, which operated so successfully during the war, was followed by the parallel 20-in. products line which first demonstrated that premium-grade gasolines in huge volumes could be batched through a large-diameter pipe line without preceptible contamination.

Since then, there has been a steady march toward larger-diameter lines with wider pump-station spacing for all purposes. Recent studies show that an 8-in. line with stations 50 miles apart can move 20,000 bbl. per day while a 32-in. diameter line with 100-mile spacing can pump 500,000 bbl. per day, 25 times as much oil. This can be reduced to a simple ratio which shows the 8-in. line will need four times as much steel and twice the station horsepower per barrel as compared to the 32-in. line, resulting in one-fourth the over-all investment per barrel with proportionately lower operating cost.

This means the future trend will be toward larger-diameter lines and wider station spacing, especially where huge volumes of crude from prolific oil fields have to be transported to large refining centers. The use of welded steel lines as large as 5 ft. in diameter has been proved entirely practical and successful in the water-supply systems for large cities so there is no reason why lines larger than 32-in. cannot be used for crude-oil transportation.

The improvement being made constantly by the manufacturers in the quality of steel, which some day may provide an alloy steel of high tensile strength completely resistant to inside and outside corrosion, goes hand in hand with the large-diameter pipe, higher operating pressures, and fewer pump stations. The pipe fabricators have contributed their part to this progress by better methods of rolling, pressing, welding, expanding, and testing large-diameter pipe. In this connection, while the present method of welding the pipe along the right-of-way is satisfactory, it is still desirable to develop a portable electric machine which will join the pipe ends together instantaneously and thus speed up the field construction

These are the projects, recently completed or building,



Interprovincial Pipe Line Co., a 1,180-mile, 16-18-20-in. crude system from Edmonton, Alta., to Superior, Wis. (1950). Initial capacity from Edmonton to Regina is 90,000 bbl.; Regina to Superior, 70,000 bbl. daily.

Portland Pipe Line Co. and Montreal Pipe Line Co., Ltd., a 236-mile, 18-in. crude line from Portland, Me., to Montreal, Que., to parallel its existing 12-in. line. Line was built during the 1950 construction season.

Trans-Arabian Pipe Line Co. built the 1,068-mile, 30-31-in. crude carrier line from Abqaiq, Saudi Arabia, to Sidon, Lebanon. Completed in 1950. Pumping capacity with six stations is over 300,000 bbl. daily.

Gang starts dope machine for coating and wrapping operations at end of section.

Dragline with 2½-yd. bucket operating from mat of planks while digging trench for river crossing.

. . . to provide efficient, low-cost transportation of oil wherever it is needed throughout the world

by W. R. Finney

and insure a strong, safe, and uniform weld.

Better Coatings

The protection of pipe lines from external corrosion is still a problem. Progress is being made and credit should go to the pipe-line research groups who have developed new and better ways of cathodic protection as well as the application of magnesium blocks and similar materials for preventing pitting. In recent years, the glass-fiber wrappings have proved of real value and the quality of felts and wrapping papers has continued to improve. In addition to this, the companies making the coal tar and asphalts for pipe-line protection have demonstrated their ability to produce better products which are much easier to apply to the pipe along the right-of-way. However, a real need exists for some new synthetic coating which can be applied uniformly at the mill, such product to be durable enough to withstand all of the handling and laying and still protect the pipe surface against external corrosion under widely different soil conditions.

Synthetic Pipe Materials

Speculation leads immediately to the possibility of using composition or synthetic pipe which is completely resistant to the ordinary type of corrosion. There are several types of such pipe now available. One is a fiber-glass-reinforced plactic pipe which makes a strong, lightweight, durable conduit suitable for many purposes. There seems to be a future for this type of steel substitute but it would be necessary to develop a readily applied field joint which would be as strong as the pipe itself and in no way interfere with the laying or handling of the line.

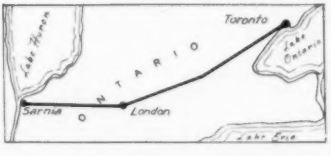
If an absolutely tight field joint for all operating pressures and conditions can be developed, the reinforced plastic pipe will have a definite advantage for refined-products lines because of its inherent characteristic of resisting internal corrosion. This latter problem has worried the gasoline-pipe-line companies for many years and, while there are several very successful inhibitors being used, there still remains the difficult problem of removing the water and very fine rouge-like sediment from the stream of gasoline.

Many filters have been tried such as specially woven cloths, fibers, and metal screens of all descriptions and it still may be possible to improve some of these, including the magnetic type. In the meantime, the lines are using ordinary excelsior which serves the purpose but calls for frequent replacement of the filter bed. It seems probable that some ingenious engineer or diligent research man will develop a piece of apparatus that will remove all moisture and sediment from the stream automatically and

with which the author has been particularly concerned

Plantation Pipe Line Co. is building a 432-mile, 18-in. line from Baton Rouge-Bremen, Ga., and 275-mile, 14-in. Bremen-Charlotte, N. C. New facilities parallel existing line, raising capacity to 220,000 bbl. daily.

Iraq Petroleum Co., Ltd., is currently building a 556-mile, 30-32-in. crude line from Kirkuk, Iraq, to a marine terminal at Banias, Syria. Completion in 1952. It will function with existing 12 and 16-in. lines.



Imperial Oil, Ltd., is undertaking construction of 195-mile, 10-12-in. products pipe line from Sarnia via London and Hamilton to Toronto, Ont. Project is scheduled to start operating in the summer of 1952.

Radio communication and gage instruments in pump-station office facilitate control of crude-oil pipe-line operations.

continuously. This offers a real opportunity for some progressive concern to bring out such a unit.

Station Equipment

There have been a number of interesting developments in pipe-line equipment in recent years and probably the outstanding thing, as far as operating economies are concerned, is the dual fuel engine. This type of equipment is being made by several large manufacturers of diesel engines who produce a unit that will operate on 100 per cent diesel fuel but which can be thrown immediately over to run on as high as 90 per cent gas fuel. In addition to the very high thermal efficiencies attained by this type of internal-combustion engine, it has a distinct advantage in oil fields where natural gas is available.

There has also been a steady trend toward the use of motor-driven pumps in pipe-line stations wherever electric power can be made available at reasonable rates. This is a logical development as motor-driven equipment requires less space and is more easily controlled by automatic devices. In this connection, several new things have been developed lately by a number of pipe-line companies. One of these is the remote-type gage. These gages can be applied to storage and supply tanks as well as for pressures and temperatures throughout the station. Remote pressure gages not only save time and trouble for the operators but eliminate the danger of carrying volatile gasoline through a pressure tube to a gage board in a room where a slight leak or break might cause an explosion.

There has been similar progress made on other station equipment. Another new development is the multiple registering meter. These are especially adaptable to refined products lines handling different batches of gasoline which must be measured accurately. While high-speed centrifugal pumps have proved entirely satisfactory over the years for moving both crude and refined products, in the latter it has always been a problem to prevent undue wear on the rotating shaft through the packing gland. Some new devices are now being successfully used both of the liquid-seal type and the spring-controlled surfaces where the wear is taken vertically so does not damage the rotating shaft. These improvements allow centrifugal pumps to be used safely, economically, and continuously on all types of gasoline including butane and propane.

In the layout and design of modern pump stations, the engineers and operators are taking every precaution against accidents and explosions. The electrical people have contributed immeasurably in this regard in developing portable cabinet-type starting and operating controls which minimize the danger of trouble from exposed electrical contacts. These types of cabinets can be installed in a solidly built, pressurized room so the chance of stray gas seeping into the electric equipment is remote.

In these same stations, master switches are being placed some distance away from the building so that the operator can shut off all sources of electric power on a moment's notice. In addition to the pressurized room, pressure and exhaust fans are installed in the pump rooms to change the air continually so as to minimize chance of trouble from small leaks of oil and gasoline.

THE AUTHOR

WALLACE R. FINNEY

Wallace R. Finney, pipe line adviser to Standard Oil Co. (N. J.), has been associated with the oil industry in various capacities for about 37 years. At present he is a vice president and director of Interstate Natural Gas Co., Inc., a vice president and director of Plantation Pipe Line Co., and a director of Interstate Oil Pipe Line Co. In January 1948 he was named as an alternate director of Middle East Pipelines, Ltd., and assisted with the planning of the Middle East, Iraq, and Trans-Arabian pipe-line projects.

During World War II Finney served as chairman of the Temporary Joint Pipe Line Engineering Committee which supervised the design and construction of the Big Inch and Little Inch War Emergency Pipelines. Since June 1944 he has been a member of Jersey's coordination committee and acts as chairman of the subcommittee on pipe lines. He is also chairman of the subcommittee on tanker terminal facilities and in addition is chairman of the pipe-line research and development advisory committee.

In addition to the above, the pipeline managers, engineers, and research people are continually working to improve station equipment as well as operating technique. One of the new things now being worked on is the application of the gas turbine to pipe-line pump stations. This comparatively new unit has been developed to burn gas or liquid fuel, so that it can be readily adapted to oil fields where natural gas is available, or used at the trunk-line pump stations where liquid fuel is always obtainable.

So far the indicated fuel economy of this new turbine does not compare too favorably with gas or diesel engines but the unit has other advantages such as light weight and portability. Further, it has a wide speed range and can be directly connected to a centrifugal pump making a very compact and efficient pipeline unit. This type of prime mover will have distinct advantage in iso-

(Continued on page 258)

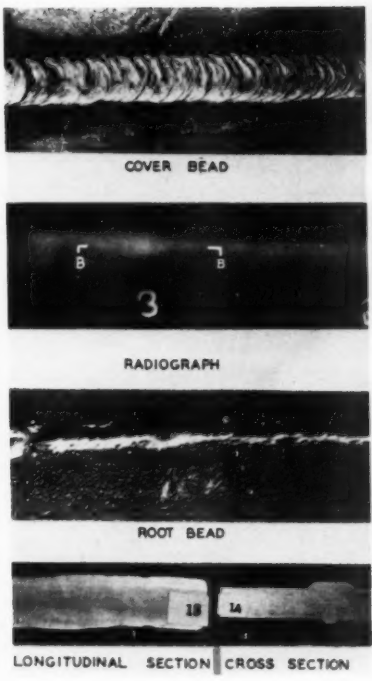


Fig. 1.

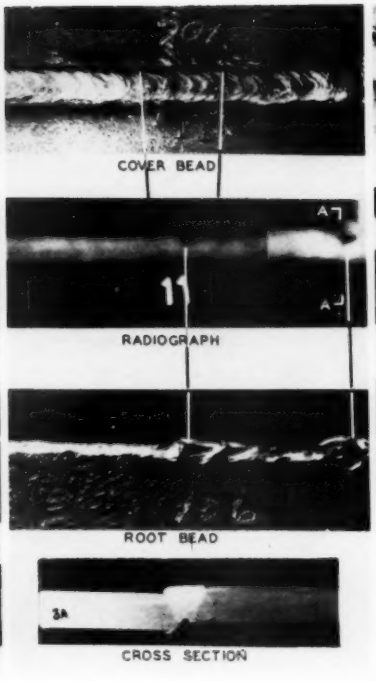


Fig. 2.

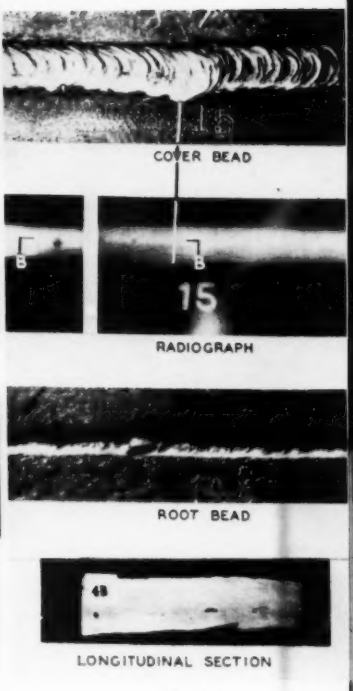


Fig. 3.

These figures along with the others accompanying this article are photographs of actual specimens. They were especially prepared to illustrate specific points brought out in this comprehensive discussion on radiograph interpretation.

How to Interpret Radiographs of Pipe-Line Welding Defects

by A. G. Barkow

USE of radiography as an aid in the inspection of field welds of crosscountry, high-pressure transmission lines for natural gas, crude oil, and petroleum products has been of very recent origin. It is rapidly being applied to all modern construction of this type as a highly desirable nondestructive test method.

Radiography is a general term applied to inspection where both gamma-ray and X-ray methods are used with photographic film as the detecting device. Radiant energy from these sources is of extremely short wave length or high frequency, well beyond the high side of the visible spectrum. These rays have the property of being able to penetrate materials through which ordinary light cannot pass. Since all materials absorb varying amounts of this radiant energy, depending on their density, thickness, and atomic number, the rays can be used to disclose differences in composition of the materials themselves.

X-rays are produced electromechanically by the impingement of cathode rays on a tungsten target in a special type tube. Voltages ranging generally from 100,000 to 300,000

In the opinion of the author . . .

1. The outward appearance of the weld does not necessarily indicate soundness of the weld.

2. Most defects are due to poor workmanship in alignment and root bead welding.

3. Length of the weld defect is not the only criterion of its deficiency. Shape and density must also be considered.

4. The radiographic inspector must be extremely observant of details and must be capable of ready analysis of radiographic indications.

To gain experience, the inspector should complete physical destruction tests on all welds rejected, taking care that the defective section is opened to reveal the extent of defect indicated by these examinations.

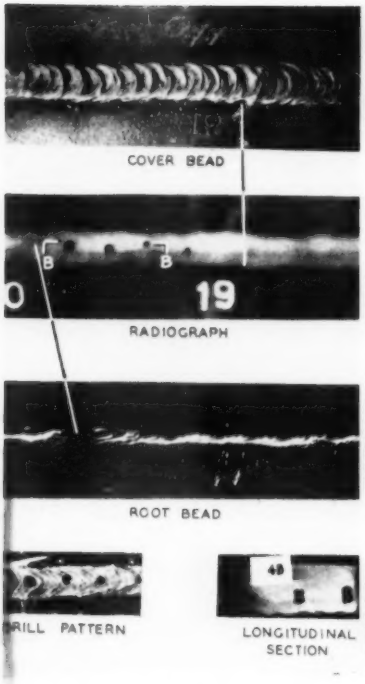


Fig. 4.

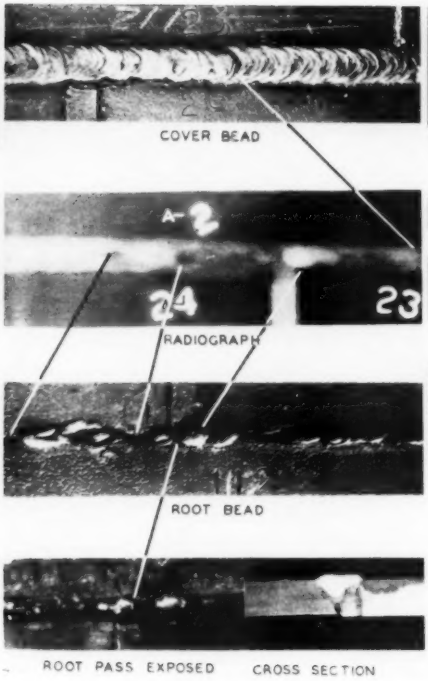


Fig. 5.

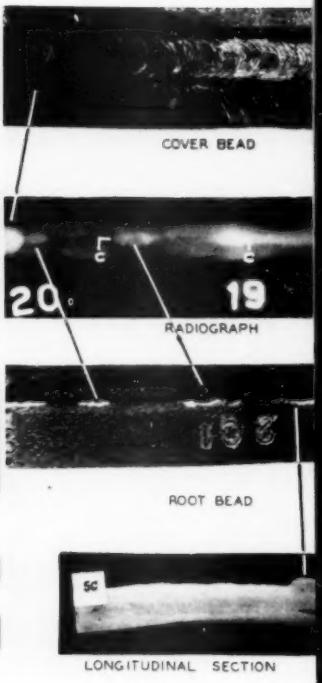


Fig. 6.

with a current of 5 to 10 ma. are used for this purpose, producing a radiation having a wave length of from 0.04 to 500 A. An Angstrom unit, abbreviated A, is equal to 1/100,000,000 cm. An ordinary ½-in. steel plate can be penetrated in approximately 2 minutes with a 150,000-volt radiation to produce a suitable radiograph or radiation shadow-photograph film.

Gamma rays are electromagnetic vibrations induced by the disintegration of radium and other radioactive elements. This disintegration is a continuous process, uncontrollable and of constant intensity. Radiation thus produced is of a considerably shorter wave length than that of the X-ray, being in the order from 0.01 to 1.4 A. Radiation being constant, intensity of its penetration is controlled by the focal distance between source and object and the exposure time. The usual quantity of radioactive materials used in pipe-line examinations will penetrate ½-in. steel plate in approximately 40 minutes to produce a suitable radiograph.

The high-frequency rays used in radiographic work act on the emulsion of a film similar to that when a photographic film is exposed to light. Intensity of radiographic exposure may be increased by use of lead-foil screens or screens made of some radio-fluorescent material.

The radiographic film is really a photographic negative shadow picture showing variations in density of the various materials included in the radiographed object and variations in thickness of the object and included materials. As an example an X-ray radiographic film of a ½-in. steel plate will be a uniform dark gray color. A weld included between two such plates would be considerably lighter in color because of the added thickness of the root and face beads. If these beads were removed flush with both surfaces of the plate, practically all traces of the weld would disappear when radiographed. However, a slightly lighter band would be evident because of differences in metal density.

Coming back to the plate with the weld, the light band on the film would show a ripple effect which may be readily identified with the ripple of the weld bead itself. The light band in the film will really consist of two bands, the root and face beads, one superimposed on the other. Of the two bands, the narrow one will be somewhat lighter and will show the characteristics of the root bead, which image it actually is, while the wider band will reflect characteristics of the face bead.

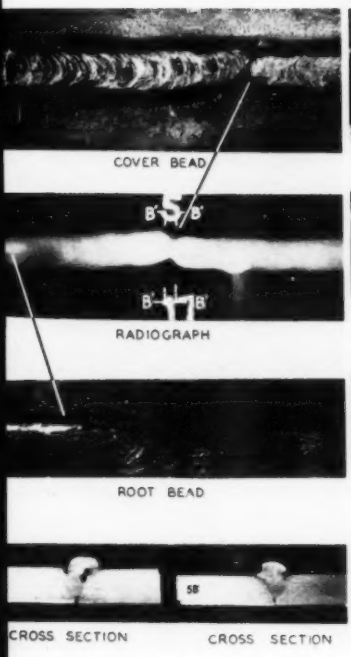
Explanations

Voids and nonmetallic inclusions in the weld, reducing the over-all density of the section will appear on the radiograph film as dark spots or streaks depending on the nature of the inclusion or defect. Interpretation of these markings is of vital importance in the utilization of this means of inspection. Proficiency in the interpretation of radiographs is a matter of experienced judgment and can be gained only by intelligent study and a basic knowledge of the natural shape and principal location of various weld defects. This article is aimed toward describing and illustrating the more common defects both as found

THE AUTHOR

Armand G. Barkow, materials inspector for Natural Gas Pipeline Co. of America, on completion of his formal education, went to work in the metallurgical laboratory of A. O. Smith Corp. in Milwaukee. His experience in radiographic inspection of metals dates back to 1930, making him one of the pioneers in this field.

In the late thirties, Barkow left A. O. Smith Corp. to function as welding metallurgical engineer for Maryland Casualty Co. For the past 11 years he has served in his present capacity.



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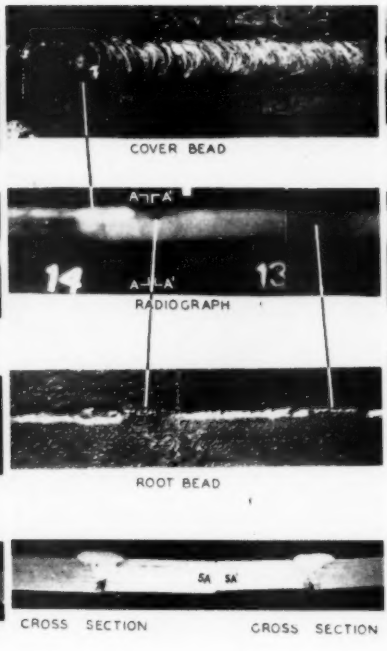

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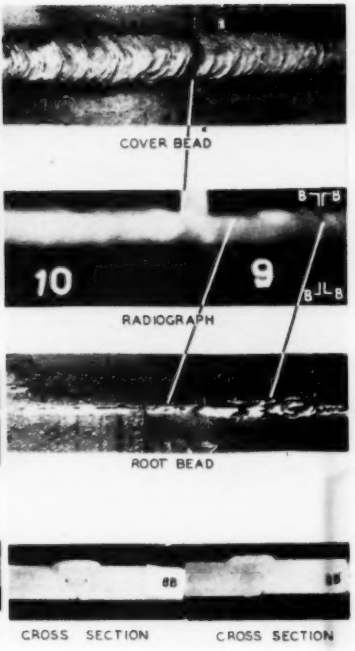


Fig. 9.

by radiographic inspection and actual examination of a cross-section of the specimen.

Penetrameters.—Since the quality of a radiograph is entirely dependent on its density and contrast, some type of measurement of density as an aid in judgment of the magnitude of inclusions and defects is necessary. Such a standard of density measurement is provided by the penetrameter. This device is made of material similar to that under radiographic observation. The standard penetrameter is approximately 1½ in. long, ½ in. wide, and usually 2 per cent of the thickness of the material being radiographed. Small holes, ranging from approximately 1/32 to 3/32 in. in diameter are drilled through the penetrameter. This gage is placed adjacent to a weld so that its image will also be visible on the radiograph. A comparison of the density of the penetrameter and the plate will indicate the depth magnitude of a defect and the clarity of the holes will indicate the definition to be expected.

All X-ray shadow images are geometric projections of actual size although some slight distortion may be encountered depending on the angle of the source of radiation to the object and the distance of an inclusion or defect to the film. Density in general is some indication of the depth magnitude of the defect.

Cover bead.—The face of the weld is a comparatively wide band—the actual width of the bead—covering the entire area to be examined. The cover-bead area should have enough density to distinctly show surface ripples, but it should not be so dark as to obscure subsurface regions.

Undercutting or riveting.—This appears on the radiograph as a dark line of some width at the junction of the weld and the pipe. A fine line in this darker area may indicate a crack at the fusion line and should be further investigated.

Excessively high cover.—Where radiation exposure is satisfactory, a cover bead of this kind will appear as a very white area, obscuring all but major subsurface defects. When such an excessively high cover bead extends for a considerable distance, the bead should be ground and reexamined so that cracks or other hard-to-find defects may not be overlooked.

Splatter.—Either on the bead or plate next to the weld this will appear on the radiograph as a light spot. Although not a defect in itself, splatter may cover some more serious defects.

Arc tracks and burns.—These result from carelessness on the part of a welder in striking an arc at the side of the welding groove. Such tracks are readily recognized on the radiograph. A burned spot may show a small "star" or lines radiating from the center which are actually cracks in the plate. Such spots should be repaired.

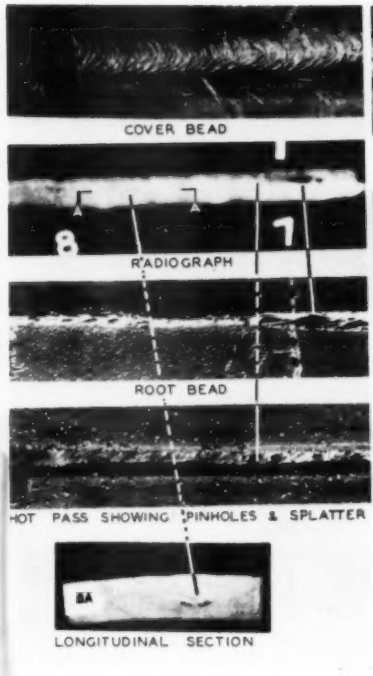
Junctions and laps.—In the cover bead these are frequently heavy, leaving an almost blank area on the film and obscuring subsurface defects. Where such areas cover considerable length, they should be removed since these are points that frequently harbor inclusions and cracks.

Surface cracks.—These will appear in the weld as rather fine lines, either parallel to or transverse to the weld. Such surface cracks are frequently found near or at the edge of the weld or will follow a ripple across the weld.

Narrow cover bead.—As shown by the radiograph this may indicate either of two conditions. The bead may actually be of less width than the subsurface weld, in which case a differential in density will be noted between the edge of the weld and the plate material or the accompanying density will indicate an offset of the pipe ends. A narrow weld due to an offset in pipe ends will usually have a very light density indicating heavier cross-section and will show practically no subsurface detail. Since an offset weld frequently harbors various defects, such areas should be thoroughly investigated.

Offset cover bead.—Where the cover bead is not placed directly over the remainder of the weld, the radiograph will show the relative positions of the cover and root beads. In severe cases these two beads may be side by side instead of superimposed. Such a condition may definitely weaken the weld structure.

Porosity.—Gas pockets are usually



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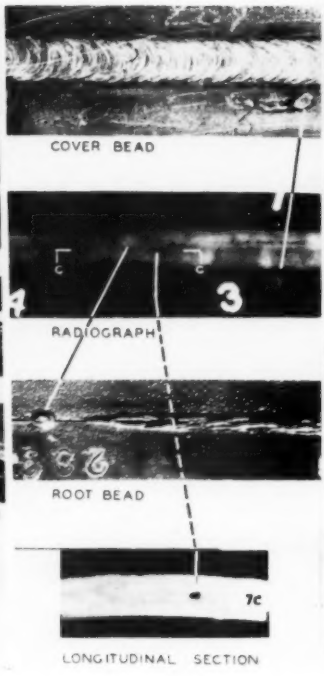


Fig. 11.

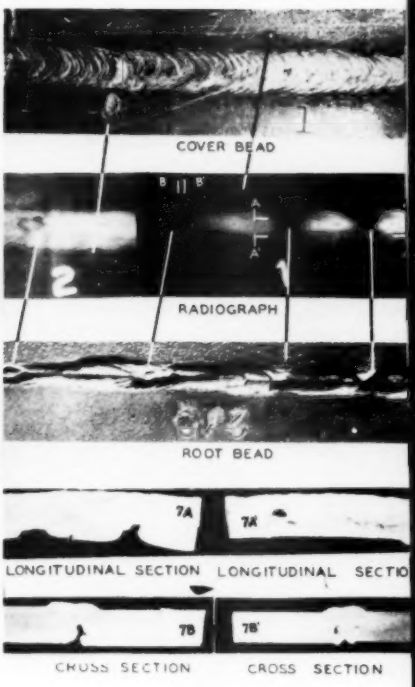


Fig. 12.

spherical and are readily recognizable as dark spots whose intensity varies directly with their diameter. Gas pockets are not peculiar to any one spot in the weld and may be fairly well scattered.

Slag and wagon tracks.—Isolated slag deposits usually form an irregular body and are most frequently found at the edge or fusion line of the particular bead. The most frequent type of slag deposits is found between the first or root pass and the second pass. Such slag deposits may be quite long and appear as lines of some width. Where such lines are found on both sides of the root bead they are commonly referred to as wagon tracks. These frequently have considerable length but seldom are of excessive width. Isolated slag pockets on the other hand frequently have notable width as well as length. Generally the density of a slag inclusion is rather uniform throughout.

Cracks.—In the path of radiation these are readily distinguished as fine

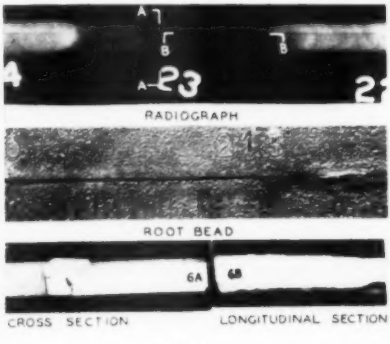


Fig. 13.

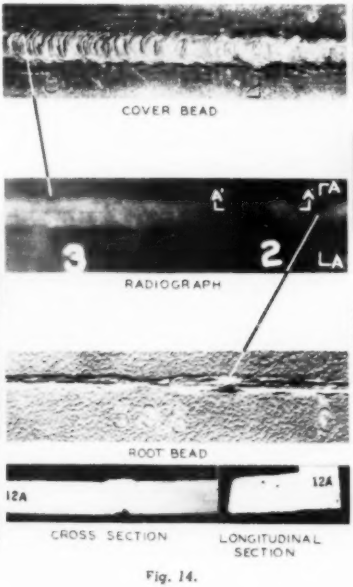


Fig. 14.

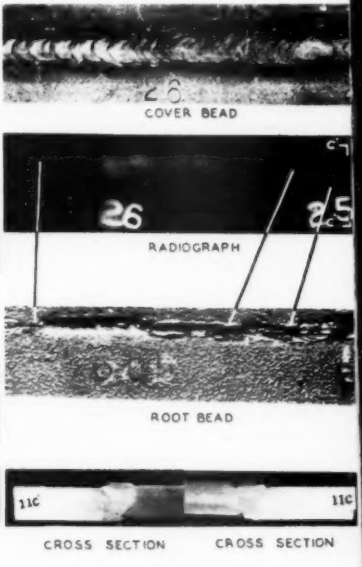
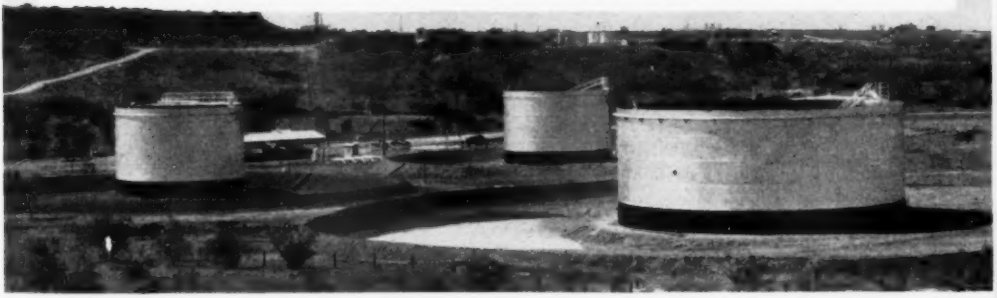


Fig. 15.

It floats on *Top* . . . but gets to the *Bottom* of Three Major Storage Problems



the HORTON* Floating Roof eliminates the vapor space that causes the problems

When you're storing gasoline or crude oil, the three major problems are (1) how to reduce or eliminate costly evaporation losses, (2) how to protect the tank from a disastrous fire, (3) how to reduce excessive corrosion on the inside of the tank. And the key to each of these problems is the air-vapor mixture that exists above the liquid in a cone roof tank.

It's the expansion and displacement of the air-vapor mixture above the liquid in a tank that leads to substantial breathing and filling evaporation losses. A Horton Floating Roof eliminates the air-vapor space (by floating on the liquid), reducing these damaging losses. There's little chance that vapor will escape around the edge of the deck for each roof is equipped with a Horton* seal—the *best* device ever invented to close the space between the deck of a floating roof and the tank shell.

Since it floats on the liquid, the Horton Floating Roof reduces the fire hazard. By blanketing the surface, it eliminates the air needed for combustion.

Corrosion surrenders to the Horton Floating Roof too. The bottom of the deck of each Horton Floating Roof is normally in contact with the liquid over the entire roof area. The corrosion which would take place if air was present is eliminated.

It's easy to get to the bottom of these storage problems. Ask our nearest office for information and quotations on Horton Floating Roofs for working tanks. Also on Hortondome roofs and Vaporspheres for standing storage tanks and Hortonspheres, Hortonspheroids and Hemispheroids for pressure storage.

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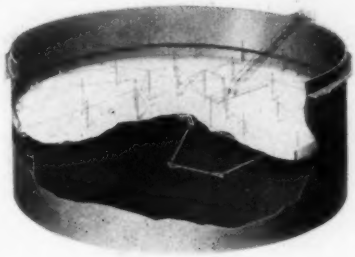

Main illustration — General view of the Pasotex Pipe Line Company crude oil pipe line station in the Scurry field near Snyder, Tex. The two tanks at the left hold 20,000 bbl. each and the one at the right has a capacity of 55,000 bbls.

These tanks are equipped with Horton PAN Floating Roofs. The construction details of a PAN roof are shown in the cutaway view above. The PAN Floating Roof stops filling and emptying evaporation losses, reduces the fire hazard and cuts down corrosion on crude oil tanks.

Where "boiling" losses are a factor, we recommend either a PONTOON or DOUBLE-DECK Floating Roof depending on the insulation needed to prevent boiling.

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Detroit, 26.....1514 Lafayette Bldg.
Houston, 2.....2119 National Standard Bldg.
Los Angeles, 17.....1523 General Petroleum Bldg.
New York, 6.....3347—165 Broadway Bldg.
Philadelphia, 3...1615—1700 Walnut Street Bldg.
Salt Lake City, 4.....525 West 17th South St.
San Francisco, 4.....1554—200 Bush St.
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Many designers are getting more pipe from scarce tons of steel by designing with Armco Welded Steel Pipe.

This is practical because Armco Pipe is supplied in a wide range of thicknesses (5/64- to 1/2-inch) with diameters from 6 to 36 inches. You can match exact job requirements without the waste of excess metal.

You'll also like the speed and economy of installing Armco Steel Pipe. Lengths up to 50 feet mean fewer sections to haul and handle, fewer field joints. Even these go together quickly as the beveled ends simplify and speed field welding.

Other advantages of Armco Pipe include flexibility — slack loops and cold bends are no problem—and a high safety factor against internal and external pressures. Use Armco Welded Steel Pipe with confidence for gathering systems, line pipe and wherever else you need dependable oil and gas conduits. Write for complete data. Armco Drainage & Metal Products, Inc., Welded Pipe Sales Division, 3331 Curtis Street, Middletown, Ohio. 201 KOME Building, Tulsa, Okla., Subsidiary of Armco Steel Corporation.

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ARMCO WELDED STEEL PIPE

ARMCO

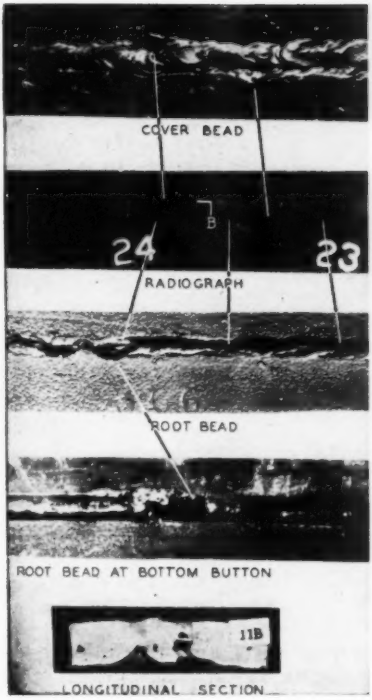


Fig. 16.

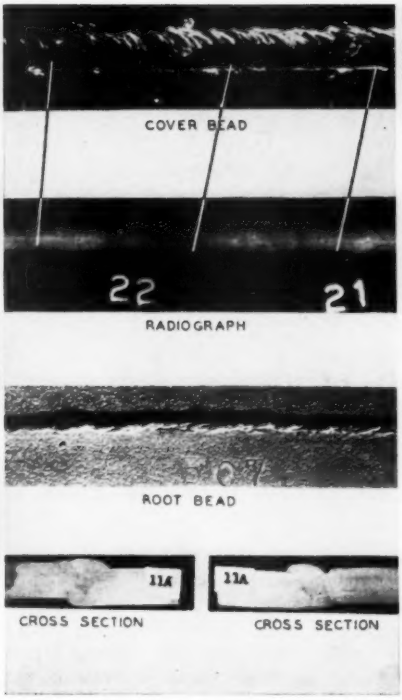


Fig. 17.

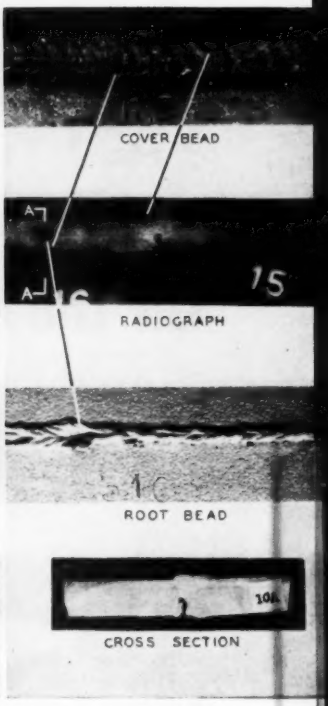


Fig. 18.

lines of considerable length but without great width. Generally they do not follow a straight course.

At an angle to the source of radiation, cracks are difficult to recognize until considerable experience has been gained. Such cracks appear as a blur with one side of heavy density fading out toward the other edge. Such cracks usually start at the edge of the root pass and follow the edge of the bevel to the top surface. Since cracks frequently do not extend to the surface, they may not be found by visual inspection of outside areas.

Cracks normal or nearly normal to the line of radiation cannot be found by this method of examination.

Lack of root penetration.—This will appear on the radiograph as a straight, wide line through the center of the weld.

Lack of root bead.—Frequently penetration will barely have been completed or will be lacking very slightly of complete penetration and no root bead will have been formed. In such instances the radiograph will show total absence of the root bead as indicated by the superimposed band, but will not reveal the line mentioned above for lack of penetration. When such a condition exists for only a short distance, the weld may be considered sound.

Lack of fusion.—Other than in the root bead this will appear as a blur similar to the angular crack mentioned above but will have considerably more definition. Frequently this condition will exist in connection with lack of penetration of the root bead. In such instances the line mentioned above will have a blurred edge on one or both sides. The extent of this blur will indicate the depth of the unfused area. Since this blur is a horizontal projection of an angular plane, the depth of the unfused area will be several times as great as the width of the blur. As an example, a blur ⅛ in. wide in a weld with a 30° bevel groove and ⅛-in. lip will reveal a lack of penetration equal to ¼ in. in depth. Realizing this, proper cognizance should be taken of such indications.

Burn through.—This will appear on the radiograph as a relatively large round or oblong area in the root area. Where such an area is indicated merely by a circle with possibly a light area in the center, the second pass has fairly filled the original defect. Where such appears as a dark area, the investigator can be sure that a void of some magnitude exists. Frequently an area will appear only slightly darker than the weld density but will contain a very black line in the center indicating that the second pass filled the original hole in the root pass, but that a shrinkage crack has developed at this point. Such shrinkage cracks may extend entirely through the second pass and are potential stress points, resulting in future failure of the entire weld.

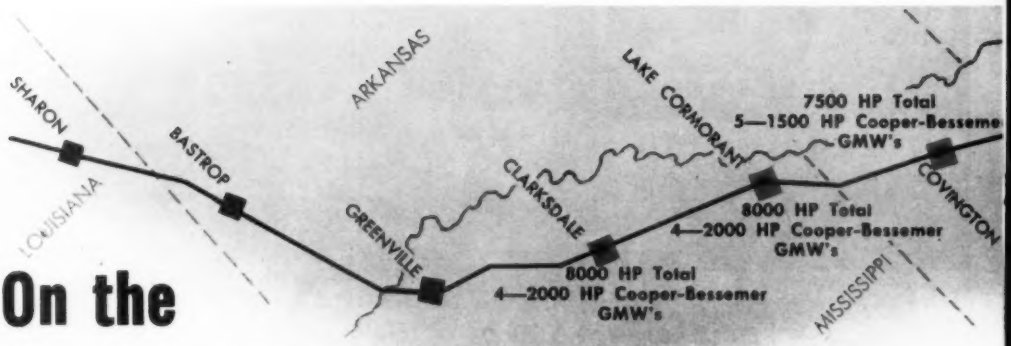
Rough root bead.—The radiograph will reveal this as a series of very light areas. This will usually be associated with a poor first pass and consequently slag inclusions and gas pockets.

Face and root sides of a good weld are shown in Fig. 1. The radiograph shows proper density and contrast. However, the slightly diagonal line and the dark spots at both ends of the radiograph are film and not weld defects.

Cross-section 1A Fig. 1 shows the several beads used to form this weld. The horizontal lines in the base plate are inclusions frequently found in plate stock and will not be revealed by radiography. The specimen has been etched in hydrochloric acid to bring out detail.

Longitudinal section 1B Fig. 1 shows the layers of weld metal. The light top and bottom bands were welded with AWS 6010 electrode while the darker center sections were welded with AWS 7010 electrode. Several very small gas pockets may be seen in the root bead. The longitudinal-section specimen was obtained from the weld area indicated B-B on the radiograph.

Some undercuts or rivers are contained on both sides of the weld shown in Fig. 2. The weld appears narrower than normal, but this due



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Jeffersontown station of Texas Gas Transmission's main line, showing compressor building in middle background.

ANGLE

Compressors

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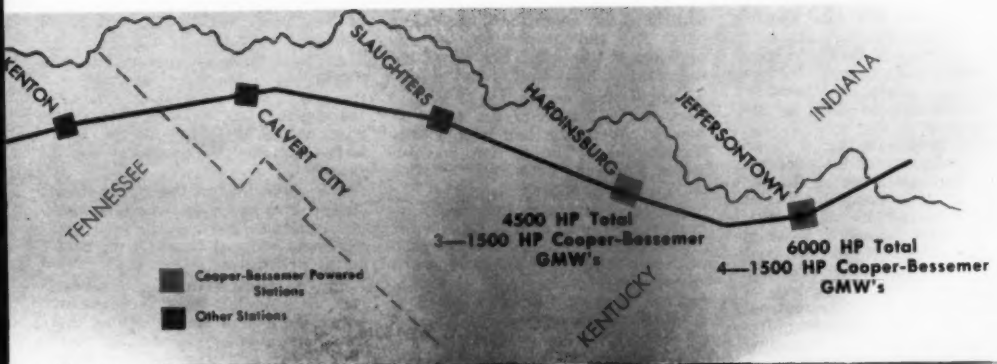
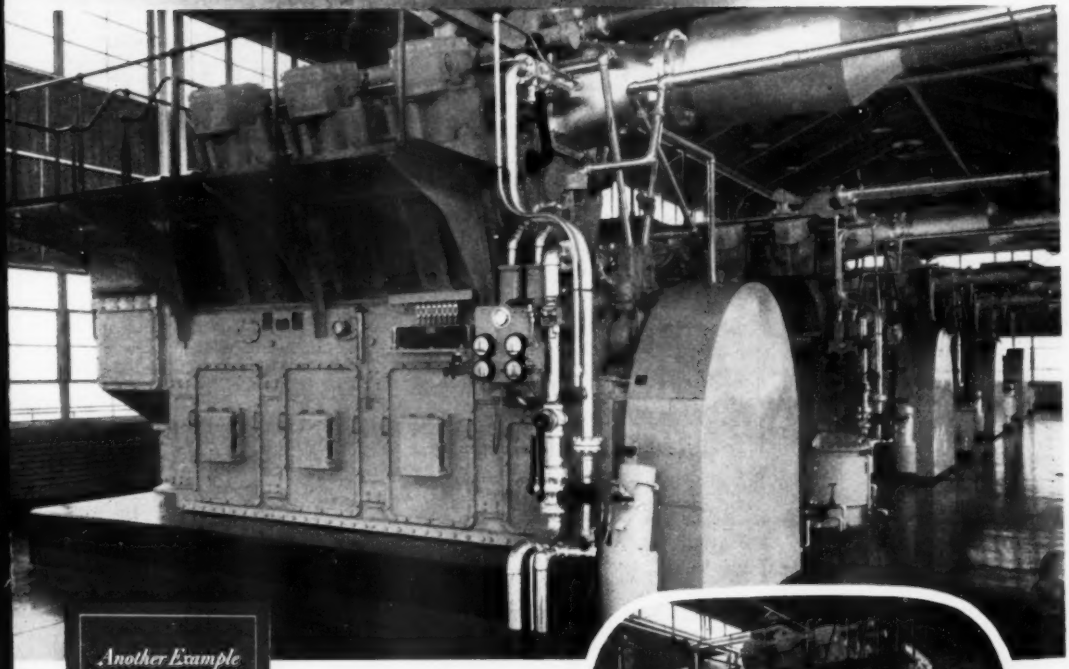
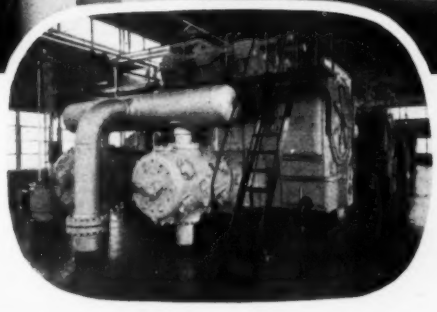
San Francisco, Cal. Houston, Dallas, Greggton, Pampa and Odessa, Texas Seattle, Wash.





Another Example of Efficient Power at Lower Cost

Line-up of four big, modern Cooper-Bessemer GMW units in Texas Gas Transmission Corporation's Jeffersontown station. These are 6-cylinder GMW's rated 1500 hp each.



Same GMW units as above but shown here from compressor cylinder side.

by Cooper-Bessemer

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to the fact that the two abutting edges of the plate were actually offset by $\frac{1}{8}$ in. The root of this weld shows good penetration except for two burn-through areas or windows, neither of which was filled by subsequent passes.

The radiograph in Fig. 2 clearly indicates undercuts of the face bead and burn-through areas of the root. Intensity of dark areas would indicate that voids left by the windows are of considerable depth. Examination of the radiograph indicates possibility of a crack at junction of girth and circumferential welds, but this can be identified with the root as a cold lap of metal extending from the second pass through the "window" without fusing properly.

Cross-section 3A Fig. 2 shows the flow of weld metal in an attempt to fill such a hole with subsequent passes. The root metal flowed out to both sides to cause cold lap on the lower plate surface, the second pass merely bridged the hole, but the third pass actually completed the cover. Unfortunately this cross- section was not in the center of the window and thus does not show the full depth of the void. Some rivering may also be noted at the side of the cover bead as shown by the cross-section. The cross-section specimen was taken from the area indicated A-A on the radiograph photograph.

The weld shown in Fig. 3 was made to approach a near-perfect one. Four holes of various diameters were were drilled into the pass immediately under the cover pass. An attempt was made to burn out these holes with an exceptionally heavy pass. Both face and root passes are nearly perfect except for a little wobble in the cover due to the heavy pass. The radiograph revealed the presence of the holes, indicating that the attempt had failed.

Longitudinal sectioning 4B Fig. 3 showed the bottom of the holes although penetration had been exceptionally deep. The section was removed from the area B-B indicated on the radiograph.

The above experiment was repeated except that the holes were drilled deeper and normal cover bead was used (Fig. 4). The radiograph shows very dark spots indicating considerable depth to the voids. Longitudinal cross-section 4B Fig. 4 confirms the indications. The very shallow cover with holes completely devoid of metal confirms the theory that succeeding passes cannot wash out pinholes to a satisfactory degree and a determined effort must be made to repair these defects. The longitudinal section was taken from the portion of the weld marked B-B on the radiograph.

The cover bead of the weld shown in Fig. 5 is quite satisfactory over the crossweld. On the other hand the root bead is very rough indicating very narrow spacing of the original root gap which caused considerable difficulty to the welder. A short length was not penetrated. Roughness of the root bead is shown by the radiograph but no serious unsoundness at this point is indicated. However, the unfused length shows up quite dark with a certain amount of flare which might indicate angular nonfusion or fusion crack.

At point A-A a cross-section, 2A Fig. 5, shows the tight root and unfused void with a shrinkage crack in the second pass. A view of the root pass before the filler passes were added explains the roughness at this point.

The cover pass in Fig. 6 is normal except for a heavy lap where another electrode was started. The root pass has some unfused length with occasional penetration.

The radiograph in Fig. 6 reveals lack of complete root penetration, but absence of a line indicates that the penetration is essentially complete. This is borne out by small deposits of metal on the root side where no actual bead exists. The radiograph also reveals several small slag deposits in some pass above the second pas.

The longitudinal section (5C) Fig 6 shows these slag deposits between the second and third passes. This section was removed from the section of radiograph marked C-C.

A definite attempt was made to start all passes at one point, welding in both directions from this point (Fig. 7). The cover bead shows a good surface, but with minimum of lap between beads. The root at this point pulled together tightly preventing full penetration as shown by the picture of the root side.

The radiograph in Fig. 7 is prac-

(Continued on page 268)

Fig. 19

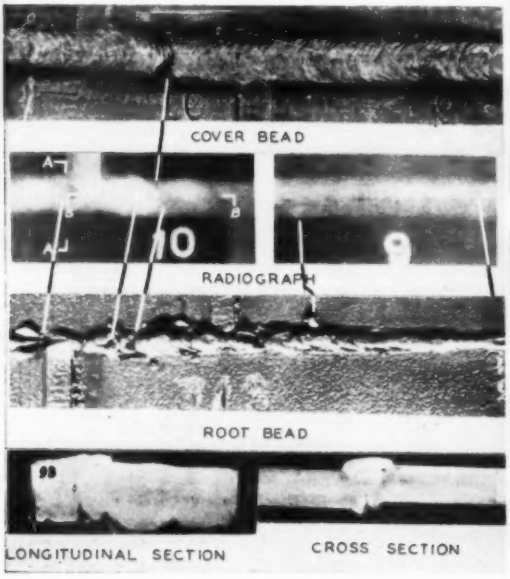
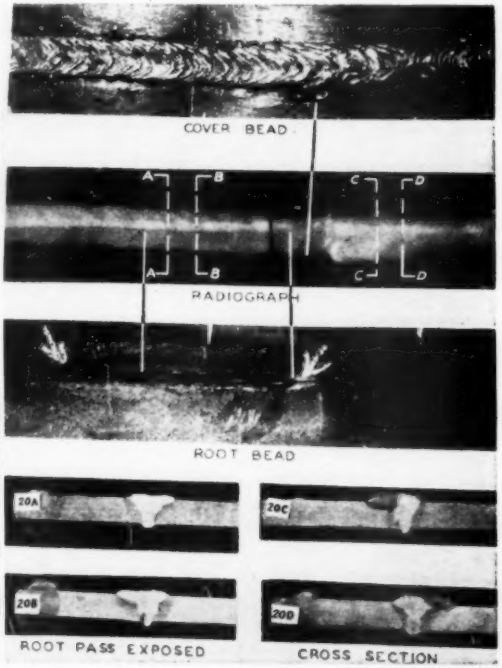
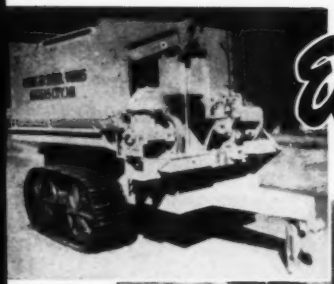


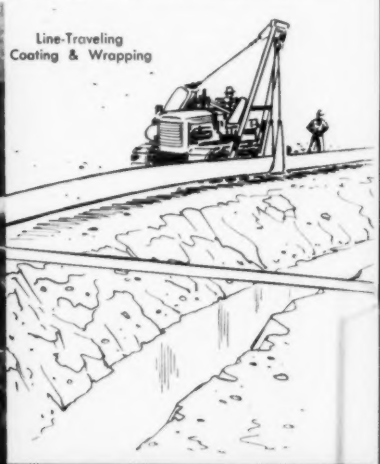
Fig. 20



Everything for the Pipeliner



American Tar Kettle



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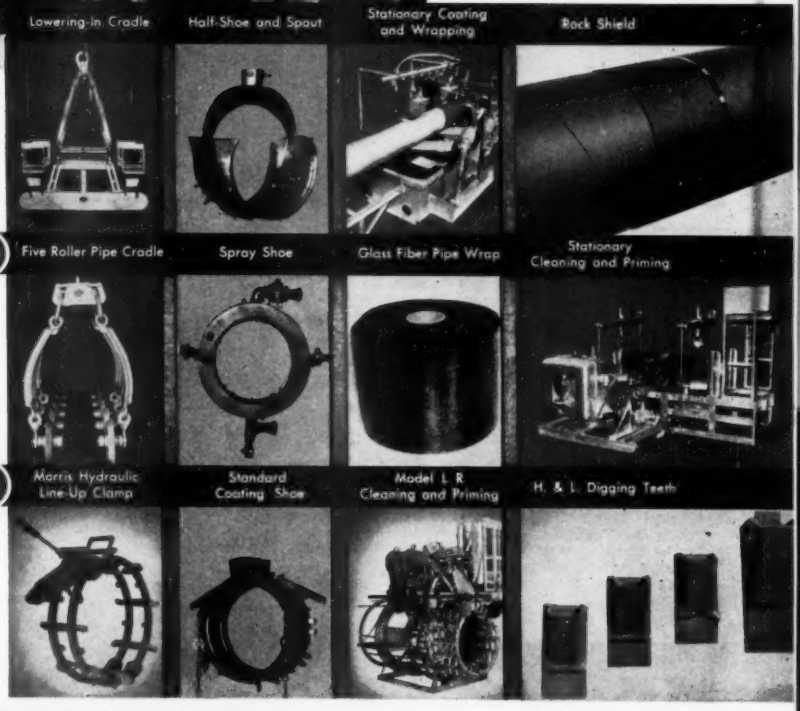

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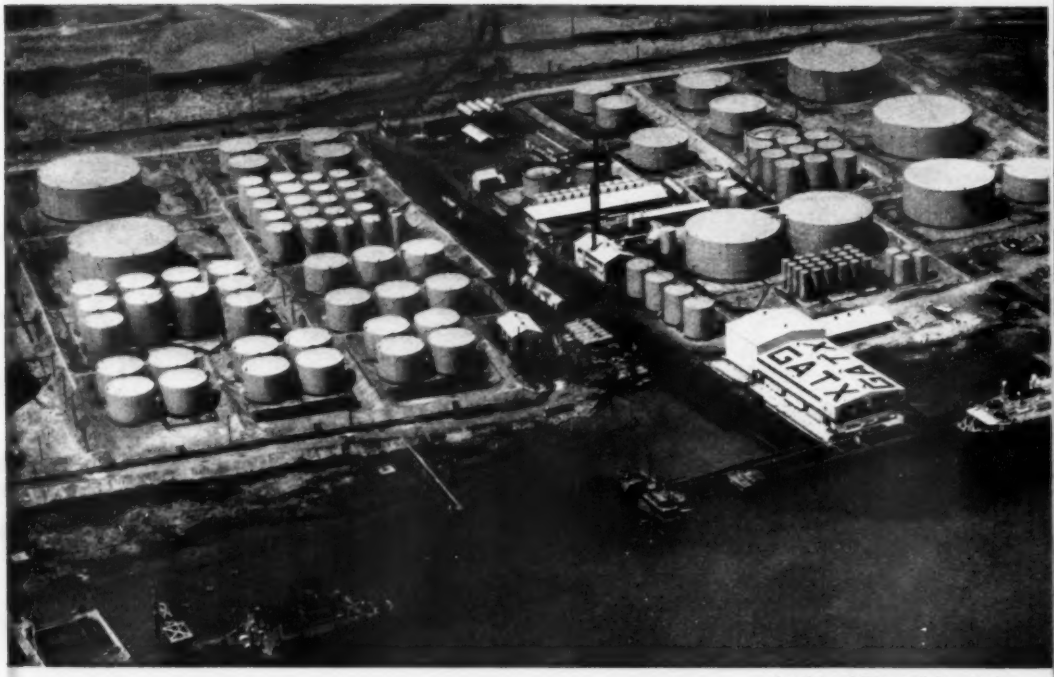

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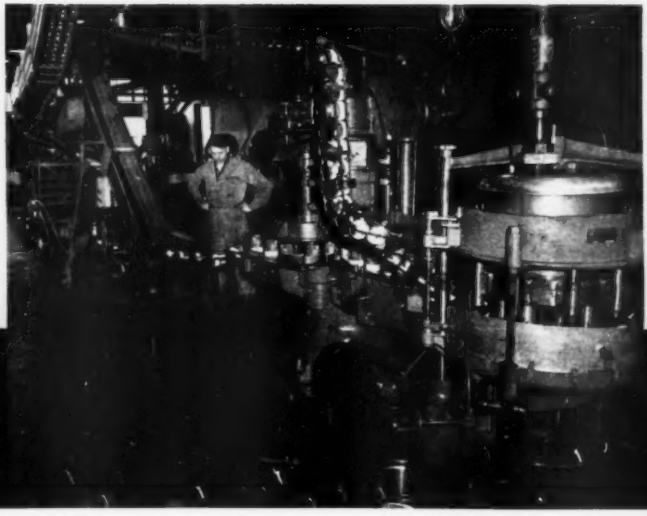

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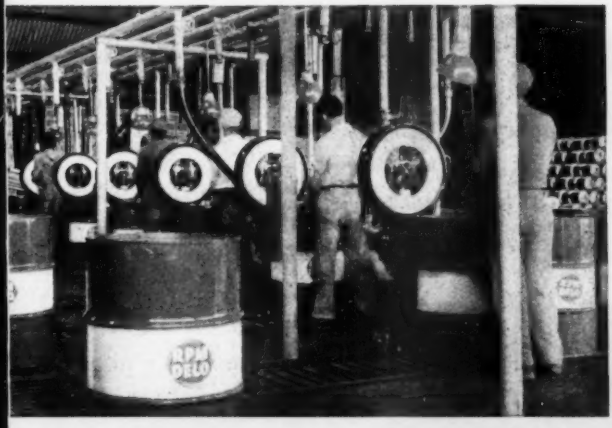

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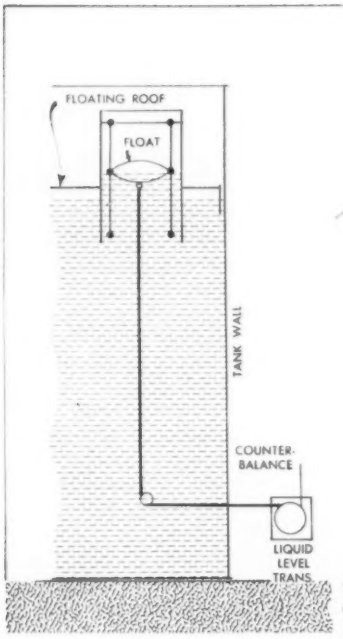

Fig. 1.

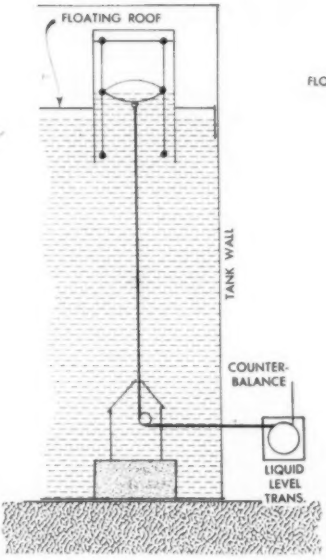

Fig. 2.

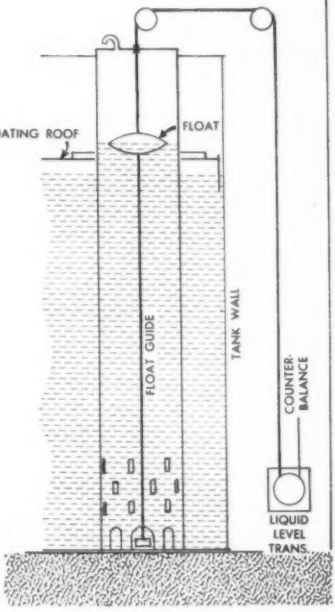

Fig. 3.

Remote-Reading Gages Improve Portland's Tank-Farm Operation

In this article, prepared by personnel of Portland Pipe Line Corp., are told the benefits the company is achieving from remote-reading tank gages which are installed on floating-roof tanks in crude service.

AT its seaboard receiving tank farm at South Portland, Me., Portland Pipe Line Corp. is achieving major benefits from remote reading tank gages on floating-roof tanks in crude-oil service. This is brought about through a unique method of installation which has given successful operation even during the severe winter weather prevalent in the locality. The method of installation was selected after several other methods proved unsuitable, and was applied first on a larger scale to four new tanks built in the summer of 1950.

These automatic gages worked so well that it was decided to take the five remaining older tanks at the main South Portland tank farm out of service this summer and install remote indicating gages in them also. At time of writing, these have just been completed. The purpose of this article is to describe several unsuccessful installations tried at first, as well as the successful installation now in use, together with the gaging benefits which have resulted.

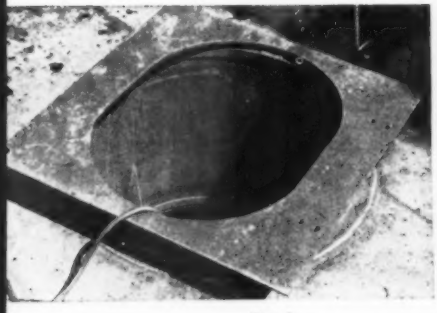

Fig. 4.

Fig. 5.

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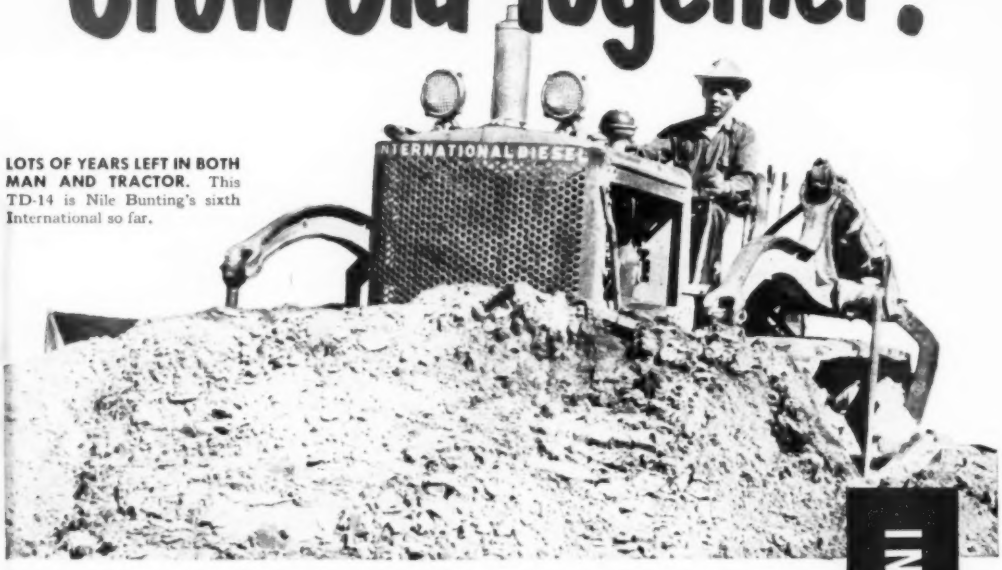
"I Guess We'll Grow Old Together!"



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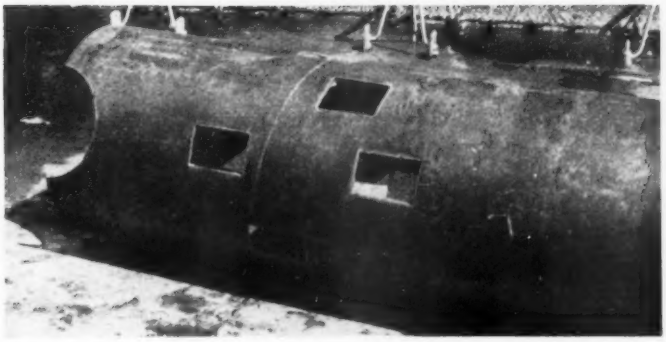


Fig. 6.

Portland-Montreal Pipe-Line System

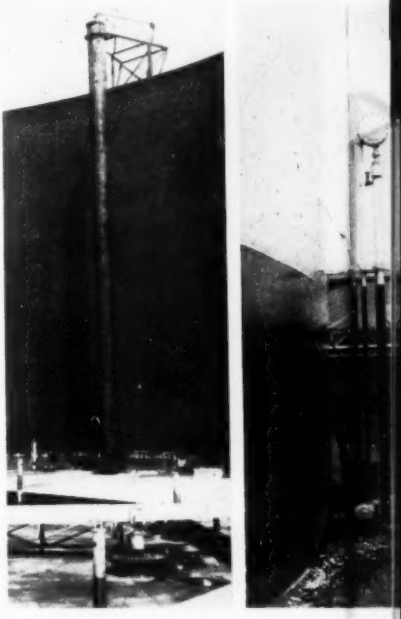
Crude oil received by tanker at South Portland is transported by pipe line from this point to Montreal East to supply four refineries at Montreal East, Que., Canada, operated respectively by British American Oil Co., Ltd.; Imperial Oil, Ltd.; McColl-Frontenac Oil Co., Ltd., and Shell Oil Co. of Canada, Ltd. A 12-in. line, 236 miles long, constructed in the summer and fall of 1941 between South Portland and Montreal East was put into operation in November of that year.

In November 1950 a second line paralleling the first, 18 in. in diameter, was completed and placed in service. There are at present three main-line pumping stations which operate both lines. These are located at South Portland, Me.; North Waterford, Me.; and Lancaster, N. H. The lines and other installations in the United States are owned and operated by Portland Pipe Line Corp., and the sections of the two lines in Canada, from the international boundary near Highwater, Que., to Montreal East, are owned and operated by Montreal Pipe Line Co., Ltd. The entire pipe line between the two terminal points is generally referred to as the Portland-Montreal Pipe Line System, and has a present capacity of approximately 127,000 bbl. of crude per day.

TABLE 1

	(A) 1946-1949 without automatic gaging	(B) 1951 without automatic gaging	(C) 1951 with automatic gaging
Throughput, bbl. per day average	61,600	120,100	120,100
Tanker arrivals per month, average	17	127	127
Tank climbings per month for hand gaging*			
On hourly checks	720	1,440	60
On daily stock checks	150	240	8
On tank-farm receipts	153	243	64
On opening and closing tanks to trunk lines	46	86	86
Total per month†	1,069	2,009	218
Average per day†	36	67	7
Full-time gagers per shift	1	2	1
Extra man required on line displacements?	Yes	Yes	No

*On many of the tank climbings more than one gage is (or was) required. †These do not include miscellaneous gages taken on auxiliary tanks in fuel-oil or other service, or special gages taken for determining condition of tank bottoms, etc., which would be approximately the same for all three columns. They do not include the hand gages required for official opening and closing gages on receipts from tankers, which are taken by the chief gager or assistant chief gager, accompanied by gagers representing the consignee. ‡While throughput is almost double that for 1946-49, average number of tankers per month has not gone up in proportion because so many supertankers carrying larger cargoes are now in service.



Figs. 7 and 8.

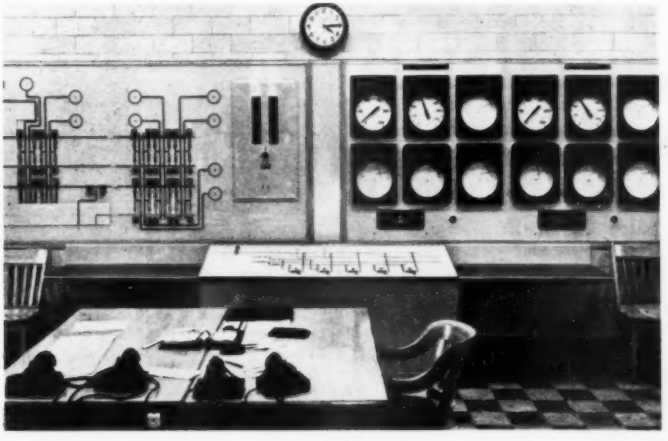


Fig. 9.

South Portland Installations

At South Portland there are two operational areas. One of these is the waterfront terminal located on the south shore of the Fore River where there is a concrete and steel finger pier, 882 ft. long, having two berths capable of docking the largest tankers presently in use.

On shore near the pier are two 140,000-bbl. floating-roof tanks and a transfer pump station. The other operational area contains the main tank farm and pumping station and is connected to the terminal by a

(Continued on page 278)

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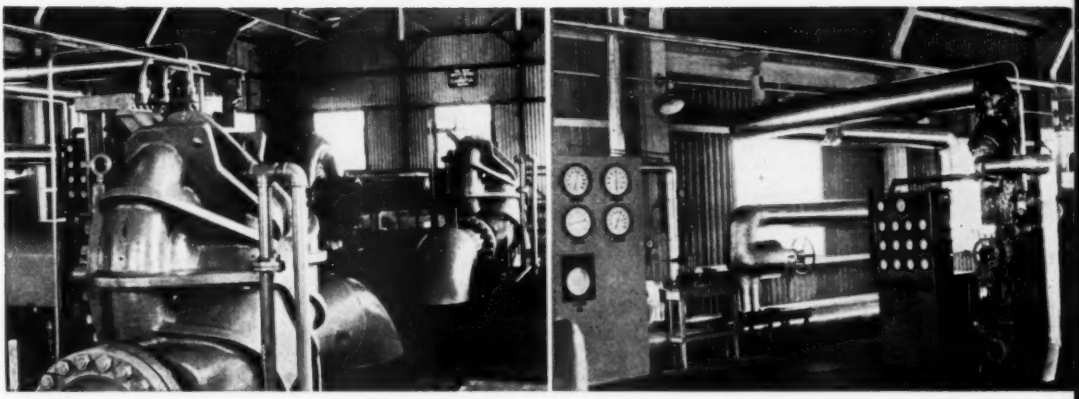


Left: These centrifugal compressors operate in series at Transco's station No. 5. Right: Control boards near 4,825-hp. steam-turbine driving units.

Transco Installs Steam-Turbine-Driven Centrifugal Compressors at Three Stations

. . . here are highpoints of the installations

THE installation of steam-turbine-driven centrifugal compressors at three new stations on the Transcontinental Gas Pipe Line Corp.'s system is the first to utilize equipment of this type in natural-gas pipe-line operations. Consequently many factors had to be taken into consideration in the selection of both compressors and prime movers.

Decision to install centrifugal compressors at three stations on Transco's main transmission system was influenced by the remarkable increase in the efficiency of the centrifugals which rose 50 per cent within a few months during 1949.

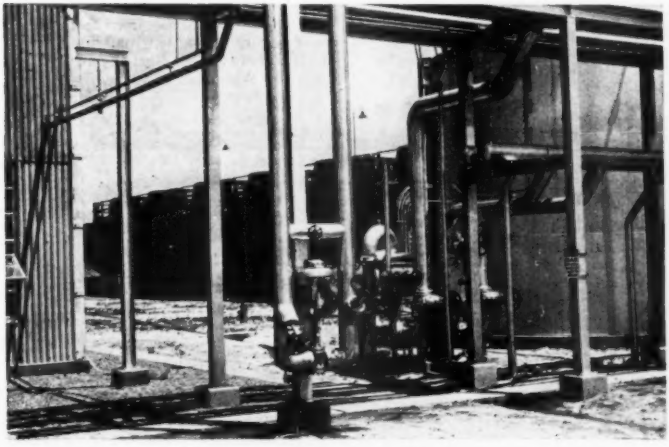
While gas turbines have been getting most of the benefit from aerodynamic studies in connection with jet research, centrifugal compressors have been deriving some important advantages from these developments—in fact enough to largely account for this efficiency increase.

Although gas-combustion turbines have promising possibilities for the future as prime movers for driving centrifugal compressors, they have not yet been established in transmission operations. The practicable alternative, therefore appeared to be to choose between electric motors and steam turbines.

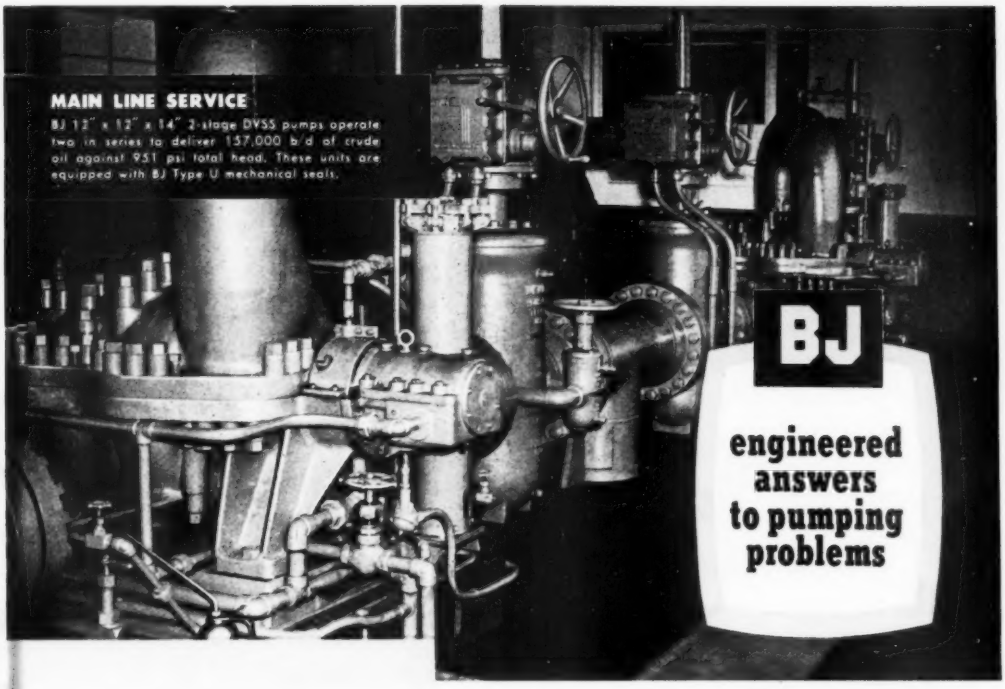
Advantages of steam turbines over electric motors for this service were indicated by available data. Flexibility of steam in varying the speed over a wide range would be particularly desirable for a system like Transco's in connection with future looping programs. While steam turbines had never been used in pipeline service in the United States, their characteristics had been extensively demonstrated at many utility and industrial installations.

The possibilities of gas-engine drive for centrifugals had not been fully determined. It may be mentioned that in the early planning it had been anticipated that a standard type of reciprocating station — with reciprocating engines and compressors— would be adopted at the three stations which were subsequently equipped with turbocentrifugal units.

For purpose of comparison between reciprocating gas-engine drive and steam turbines, it is necessary to consider results of over-all performance



Overhead piping, tank, and cooling tower.


MAIN LINE SERVICE
BJ 12" x 12" x 14" 2-stage DVSS pumps operate two in series to deliver 157,000 b/d of crude oil against 951 psi total head. These units are equipped with BJ Type U mechanical seals.
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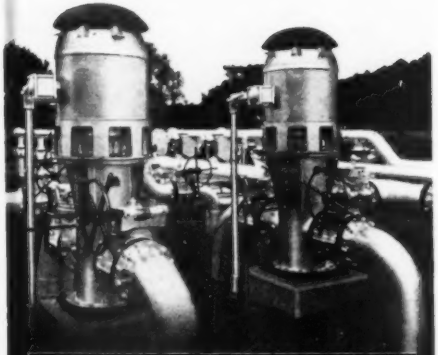

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PRODUCTS CARRIED by a single pipe line may vary from crudes to highly refined fractions – and may require pumps ranging from giant mainline units to small loading or sump models. That's why it's important to work with an established pump manufacturer who offers a complete pump line and extensive product-handling experience, plus the specialized knowledge of pipeline pumping problems. Byron Jackson Co. can supply pumps *job engineered* to your main line, trunk line, booster service, tank loading or water supply needs. And Byron Jackson pumps have established a record for rugged dependability since the first BJ pump was built in 1872. For the *engineered* answer to your pipeline pumping problems, contact your local BJ sales office or write direct.

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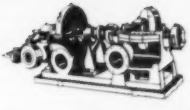
TRUNK SERVICE

BJ Hydropress-Hydroplex pumps operate on trunk and feeder line service illustrated at left . . . and small main line service is handled by BJ Multiplex pumps illustrated above.



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BJ Type TLB pumps with mechanical seal load hydrocarbons without leakage or repacking problems.

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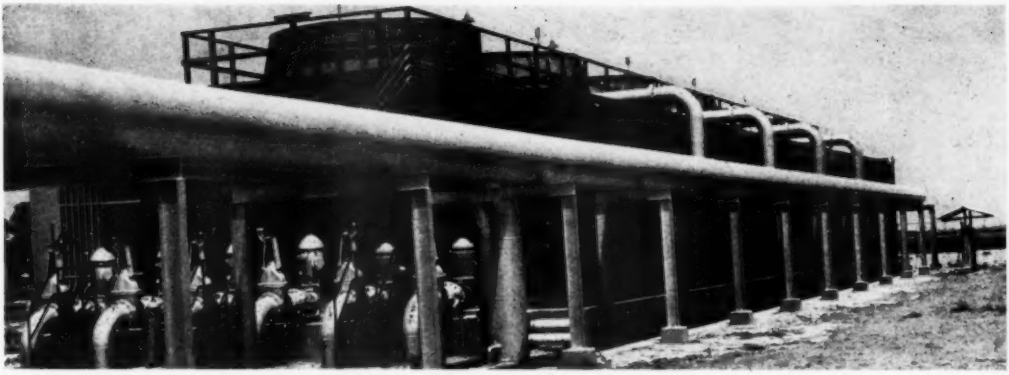


Cooling tower and pumps for supplying condenser water.

for a considerable period of time. It is naturally too early for data on this to be available. Cost items for fuel, operation, maintenance, and amortization are obviously quite disproportionate in these two types of prime movers.

Economic advantages to be attained through the flexibility inherent in automatically controlled turbines cannot be fully evaluated yet. It is possible that the savings which will be achieved through quick response to changing operating conditions may be very substantially to the credit of the turbocentrifugals when they are compared with units of other types.

Since turbocompressors are competitive with reciprocators only in the larger-size units, the opportunities for applying them will be limited to the larger plants.

The three Transco turbocentrifugal stations, designed for nearly similar service, were put in operation early in July this year. At each station the principal equipment was furnished by three manufacturers indicated as follows:

Station 5, near Eunice, La., Ingersoll-Rand Co.

Station 7, near McComb, Miss., De Laval Steam Turbine Co.

Station 10, near Clanton, Ala., Clark Brothers Co., Inc.

The status of equipment at the three stations is similar except that at Station 5, two of the three units have been installed; the third unit including a boiler will be added soon.

The stations are now handling a full load of approximately 500,000,000 cu. ft. daily to market. Suction pressures are about 550 psi. and discharge pressures 800 psi.

Operating conditions and equipment are exemplified in specifications for Station 5 as follows:

Ingersoll-Rand package-type steam-turbine-driven centrifugal pipe-line booster with condenser.

Intake pressure to station, psia.	533
First-stage discharge, psia.	665
Second-stage suction, psia.	664
Discharge, psia.	819
Gas capacity, million std. cu. ft. daily	434.2
Operating speed, r.p.m.	4,950
Horsepower, r.p.m.	4,825
Steam consumption, lb. per hour	37,500
Station suction pressure, psia.	484.2
Station discharge pressure, psia.	819

Condenser. — This Ingersoll-Rand unit maintains 27.5 in. Hg vacuum with 4,770 g.p.m. of 88° F. condensing water and is equipped with 6-in. vertical-type condensate pumps.

Turbocentrifugal compressors. — At each of the three stations are three of these main units rated at 5,000 hp., operated at 4,500 to 5,000 r.p.m. They are direct connected completely condensing types. Normally the units will operate in series.

Turbine speed is regulated by automatic controls of a type used on turboblowers at steel mills. All turbine lubricating oil is purified by centrifugal separators.

Each turbocentrifugal unit is mounted on its condenser in accordance with the trend in recent years toward packaged units for such equipment. All valving is electric operated so that it may be as automatic as possible and instrumentation is complete.

Superheat boilers.—Standard types (650 lb., 750° F. T.T.) units are installed at all three turbocentrifugal stations. These consist of the latest-design high-pressure water-tube boilers equipped with all accessories. Feed water is demineralized.

The units operate as completely closed systems. Water requirements for each of the stations is approximately 160,000 gal. per day, nearly all of which is for condenser service. Feed water is heated by exhaust steam. Auxiliaries are served by turbogenerators.

Investment cost of these turbocentrifugal stations is approximately $600,000 less per station than for a reciprocating station of the same size.

There is little difference in the space required for station facilities. However, foundations for the turbocentrifugals cost less than those for the reciprocators.

Fuel consumption for boilers serving steam turbines driving centrifugal turbines is approximately 2,000,000 cu. ft. of gas per day. This is more than the requirements of reciprocators.

Labor and maintenance are expected to be lower because of the simplicity and the reduction in the number of moving parts in turbocentrifugals. Operating experience indicates that turbocentrifugals operate for 10-year periods with relatively small upkeep cost. Water-tube boilers last for 20 years with little maintenance.

Certain economies are obtained by the absence of gas cleaners which are not required for turbocentrifugals. There is no gas cooling at these three stations. The cooling towers are entirely to serve the condensers.

This article has been prepared to show some of the high points of the first turbocentrifugal compressor installations in natural-gas pipe lining. In presenting this information it is realized that a comprehensive discussion of the comparative merits of this type of equipment will only be possible at some future time when sufficient data have been obtained from operating experience.

Principal equipment at Transco turbocentrifugal compressor stations:

Steam turbines, Ingersoll-Rand, DeLaval, and Westinghouse.

Centrifugal compressors, Ingersoll-Rand, Station 5; DeLaval, Station 7, and Clark, Station 10.

Boilers, Babcock & Wilcox, Station 5; Reilly, Station 7, and Combustion Engineering, Station 10.

Cooling towers—all Marley.

Auxiliary turbogenerators—all DeLaval and Ideal.

Lubricating-oil centrifuges—all DeLaval.

Automatic control—Askania, Bailey, Hagen.

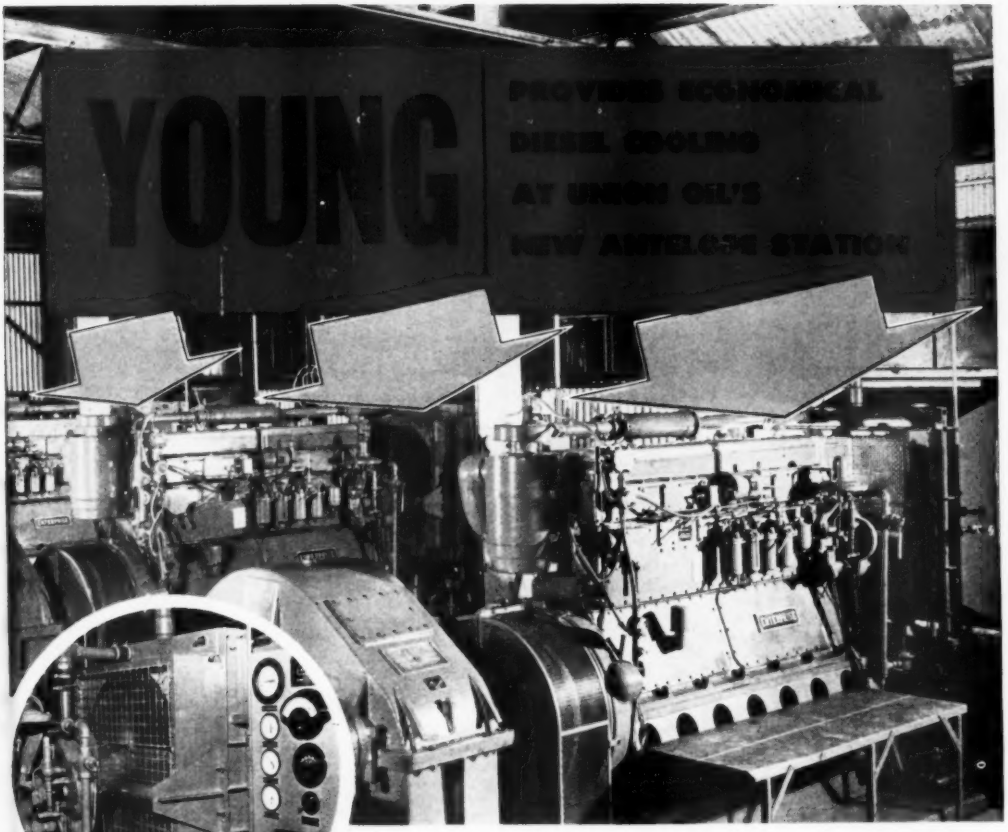
Steam flow indicator, Bailey Meter Co., Ashcroft.

Vertical pumps, Pacific Pump.

Steam gage, Western.

Emergency power generator, Hercules.

Centrifugal water pumps for auxiliary room, Allis-Chalmers.



Increased operating economy and self-sufficiency have been attained at the new Antelope Booster Station of the Union Oil Company. Young "Mono-Weld"* Radiators fit into the picture perfectly. They provide thrifty jacket water cooling for the three Enterprise Diesels installed. Also, the maintenance problem is minimized by the rugged welded steel construction of the Young units (see features at left) capable of withstanding the stresses of mobile equipment application. Your nearest Young Representative will gladly point out the advantages of "Mono-Weld"* Radiators for your applications.

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8 REASONS WHY YOUNG "MONO-WELD" RADIATORS GIVE TROUBLE-FREE SERVICE

1. Fabricated steel top and bottom provide rugged, solid support base for core.
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6. Fan shrouding specially designed to provide maximum air flow to all areas of the core.
7. Heavy-duty, over-size fan bearing assembly designed by Young to handle all radial and thrust loads.
8. Rigid fan shaft bearing and motor support securely fastened to radiator frame with formed steel reinforced members.

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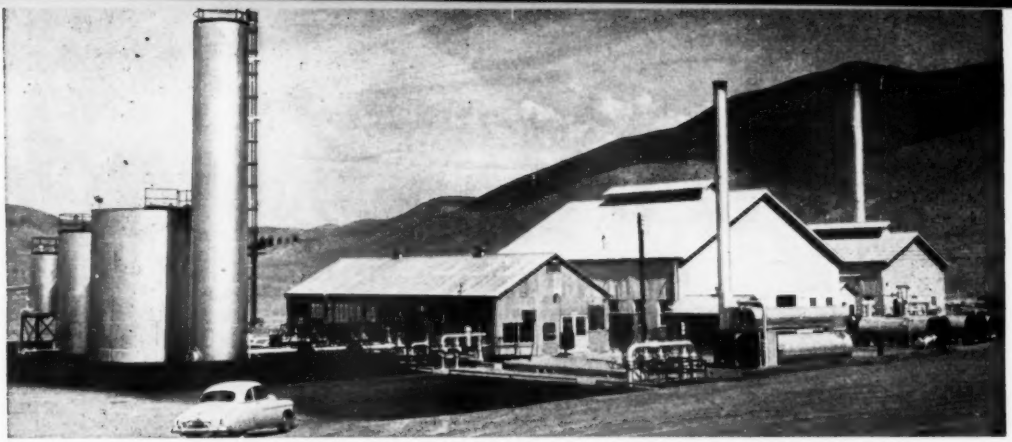


The new (left) and the old (right) Antelope pump stations. Direct-fired crude oil heater at right of the new pump house. Vessels (left to right) are crude-oil day tank, diesel oil, crude-oil storage, and 60-ft. surge tower.

Diesel Power Replaces Steam

. . . at California pumping station

by D. H. Stormont
West Coast District Editor

Three medium-speed engines in this modern station utilize 16°-gravity crude oil being pumped through line they serve

A STRIKING contrast in old and new pipe-line pumping equipment is offered at Union Oil Co.'s Antelope station 40 mlies east of Paso Robles, Calif. There, standing adjacent to a 42-year-old steam-powered station which it has replaced, is a station powered by three medium-speed diesels which utilize as fuel the 16°-gravity crude oil being pumped through the line they serve. Also new to the petroleum industry are the three quintuplex pumps which the engines drive through speed reducers.

Other features of the station which make it the most modern on the West Coast are provisions for automatic operation. Controllers automatically adjust the engine speed and discharge rate of the Antelope station as operations of the stations above and below it dictate. Controls on a direct-fired oil heater automatically regulate the amount of heat passed to the crude in accordance with atmospheric temperatures. Still another feature is the provision for exchanging heat between the engine jacket water and the lube-oil and crude-oil fuel.

Antelope serves as a booster station on Union's two 8-in. main crude lines running from San Joaquin Valley to Avila on the coast. Normally its pumping facilities are not required in the operation of the 8-in. light-oil line. Thus the new facilities primarily are for the heavy-oil line, picking up the crude as it is received from the Junction station and discharging it at a maximum pressure of 800 psi into the line leading to the Shandon station.

Since it performs solely as a booster station—pumping all crude received and no more—it was designed to operate on suction control, effected through a 60-ft. surge tower which floats on the intake line. Through a proportional controller which acts to maintain a constant level in the tank, pumping rate is either slowed down or speeded up as the volume being received requires.

In warm weather no heating of the crude is necessary at Antelope so that incoming crude flows directly to the pumps and out of the station. If atmospheric temperatures dictate that heating be performed, 600 bbl. per hour of the incoming crude is circulated through the heater. There.

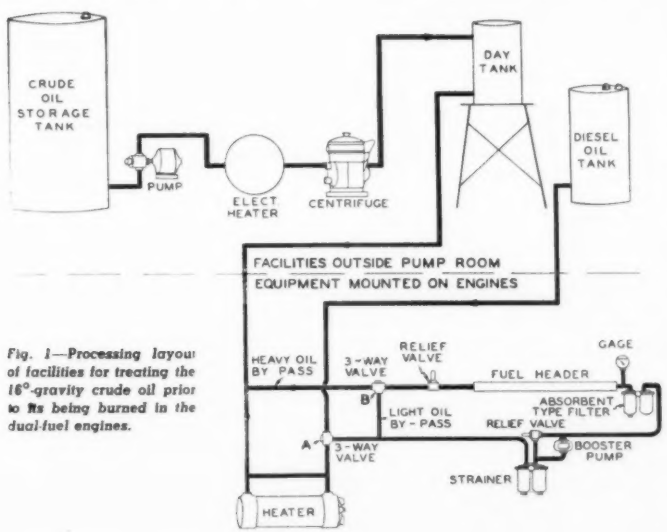
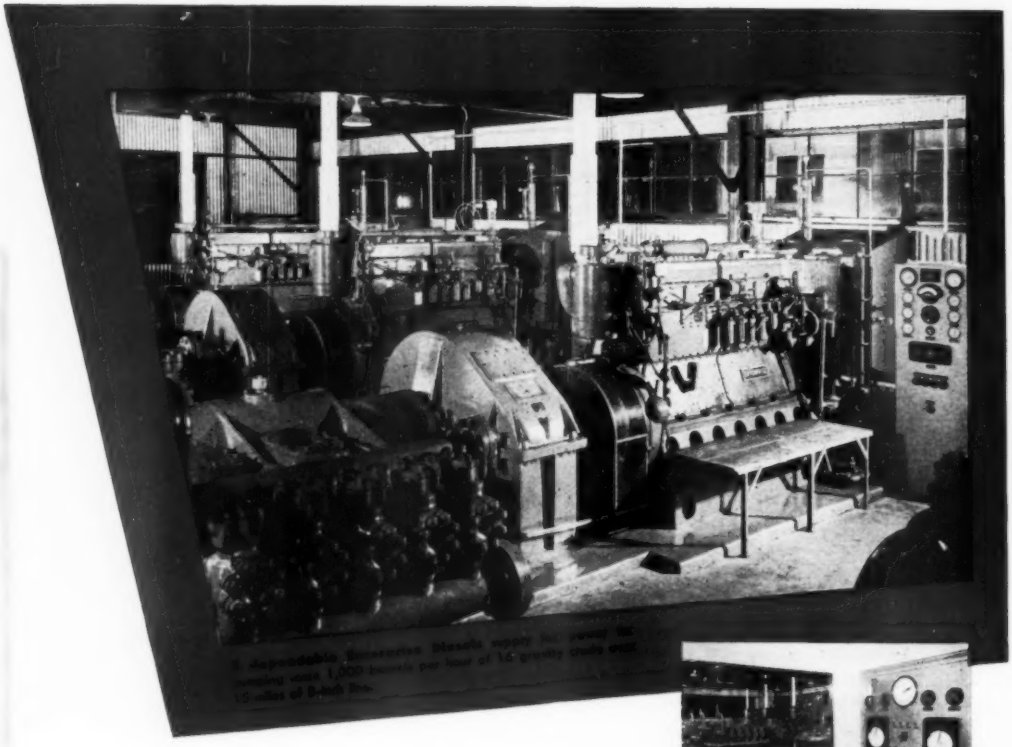
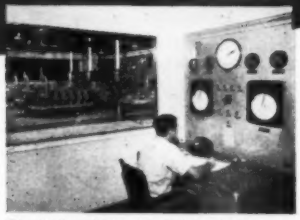


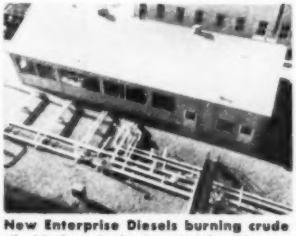
Fig. 1—Processing layout of facilities for treating the 16°-gravity crude oil prior to its being burned in the dual-fuel engines.

Crude Diet for Diesels





Plant view from central control room. This Enterprise Diesel-equipped pumping station is setting new records for operating economy.



New Enterprise Diesels burning crude oil picked up the load carried for 42 years by a steam plant—with no interruption of operations.

ENTERPRISE POWER FOR A 15 MILE UP-HILL BOOST

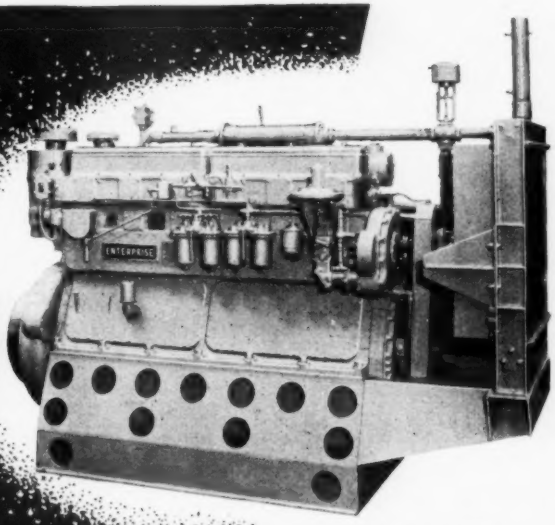
An innovation in pipeline pumping power, the *Enterprise* Diesels at Union Oil Company's Antelope Station have set new precedents for operating economy and self-sufficiency. Their ability to take unrefined 16-gravity crude from the pipeline and burn it cleanly and efficiently is the result of exhaustive testing and modifications of basic distillate fuel-burning engine models by the *Enterprise* research and development staff. This work was speeded through close collaboration with Union Oil Company's Research Department, and its contribution of specialized knowledge of fuel and lube oil abilities and properties.

As a result of the highly successful operations at Antelope Station, the pattern has been set for still another pumping plant modernization job at Union's Junction Station, which will be equipped with 6 *Enterprise* DSM-6's—also to operate on crude fuel tapped from the pipeline.

Pays Off

AT UNION OIL COMPANY'S NEWLY MODERNIZED PUMPING STATION NEAR BAKERSFIELD, CALIFORNIA

ENTERPRISE DSM-6 DIESELS BURN HEAVY PIPELINE CRUDE -SAVES 90% in fuel!



Rated 220 HP at 720 RPM, these rugged 6 cylinder Enterprise Diesels run on a diet of unrefined pipeline crude. Despite a viscosity of 800 to 1000 SSU at 122° F., a remarkably high combustion efficiency is maintained —even over extended periods at about half-load.

Replacing the steam pumping equipment which had been in operation for 42 years, modern *Enterprise* heavy fuel engines now drive pumps capable of delivering up to more than 25,000 bbls. per day. These heavy duty, medium speed pumping power units are equipped with heaters, strainers and filters which condition the crude fuel oil for uninterrupted flow through the injection system, and for high and steady combustion efficiency.

Distillate diesel fuel is used for a 15-minute warm up period, and again before shutting down to insure easy starting and clean operation. Fuel costs, as a result, have become a relatively insignificant part of operating overhead, with some 90% less fuel consumed during most of the year than was previously required to operate steam equipment.

These and many other features of *Enterprise* Diesels provide the most satisfactory solution for both new pipeline stations and modernization programs alike.

Write today for full information on *Enterprise* Diesels for pipeline pumping...*the Choice of Power Experts.*

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sufficient heating is accomplished on this portion of the crude to raise the temperature of the entire stream to about 160° F. After joining the unheated crude the combined streams flow to the pump intake header.

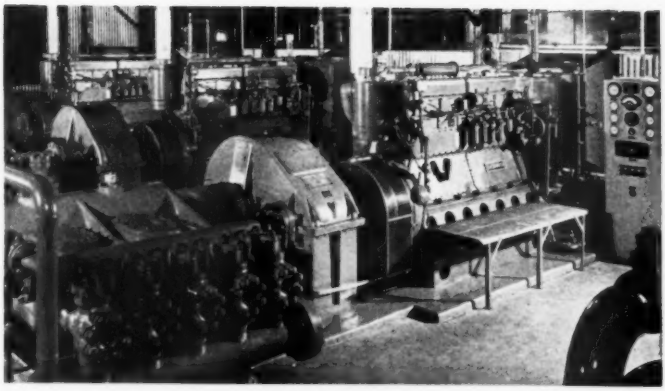
Should pressures in the discharge line exceed 800 psi., a pressure controller is actuated and crude is allowed to back through a relief line to a temporary storage tank provided at Antelope. In normal operation, however, flow is directly through the station.

Features of New Diesels

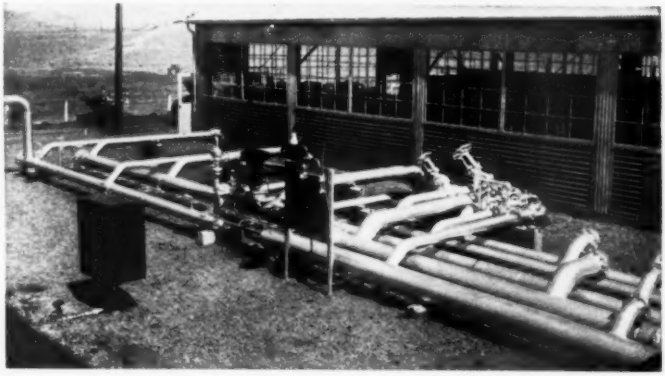
The new diesels, which bear Serial Numbers 1, 2, and 3, were designed to operate efficiently on low-gravity crudes and residuals. Light diesel fuel is used for starting and bringing the engines up to operating temperature, and for 15 minutes prior to any shutdown, but at all other times they operate on heavy crude. Properties of a typical crude being utilized as fuel are as follows:

Gravity, °A.P.I.	16
Flash point, °F.	144
Pour point, °F.	—5
Viscosity:	
S.S.F. at 70°	631
S.S.U. at 100°	1,477
S.S.U. at 130°	509
S.S.U. at 180°	150
Carbon residue, weight per cent	6
Ash content, weight per cent	0.02
Sulfur, weight per cent	1.0
B.s. and w. as received, volume per cent	0.1

The diesels are Enterprise medium-speed, six-cylinder engines rated at 220 hp. at 720 r.p.m., with cylinders of 8-in. bore by 10-in. stroke. After completing 2,500 hours of operation one engine was recently dissembled for inspection. It was found to have suffered no ill effects from its diet of low-gravity crude; wear and cylinder deposits were found to be no greater than would be anticipated in its distillate-burning counterpart. After inspection, the engine was reassembled and returned to service.



These three engines operate on 16°-gravity crude oil taken from line. The new-type quintuplex pumps shown at left are driven through speed reducers.



Pressure controller on discharge line operates a bypass valve when line pressure exceeds 800 psi., permitting crude oil to flow to relief tank.

Preparation of fuel.—Before going into the diesel's operation and special equipment, a brief description of how the crude is processed is in order. Periodically, and when shipments have properties similar to those given above, crude is removed from

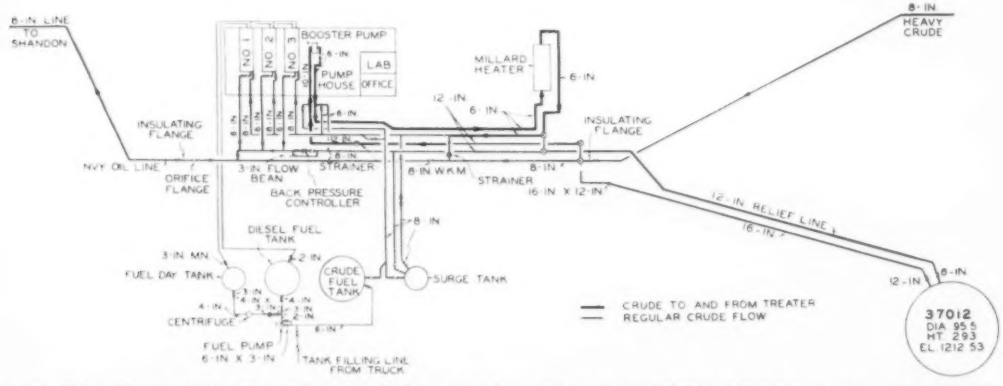
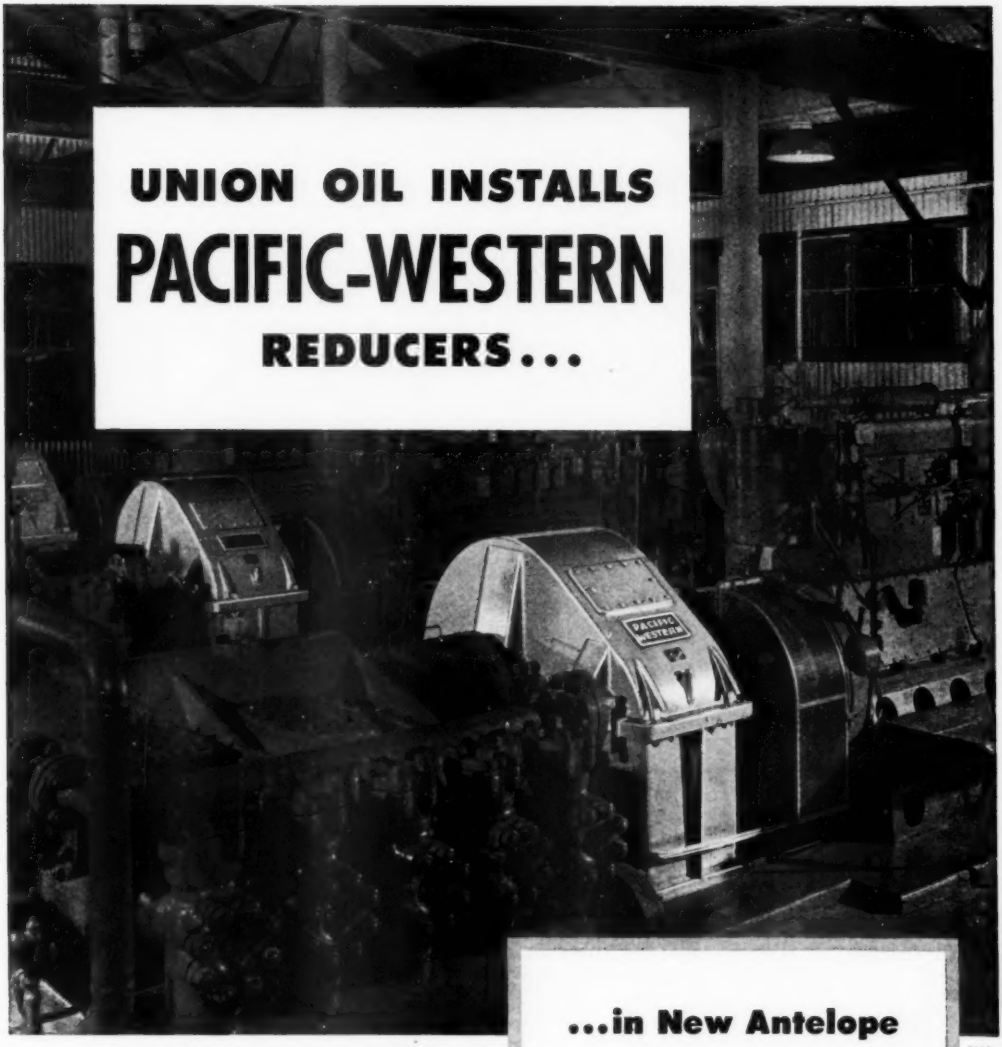


Fig. 2—Piping diagram showing flow of heavy crude through Antelope station. A parallel 8-in. light-oil line also passes through the station but only in emergencies is light crude oil pumped through Antelope station. For purposes of simplification light-oil piping and connections are not shown.

UNION OIL INSTALLS PACIFIC-WESTERN REDUCERS...



The three Pacific-Western speed reducers in the Antelope installation are rated at more than 500 horsepower each, continuous duty, under heavy shock loads. They reduce engine speed of 720 rpm to 124-rpm output for the reciprocating pumps.

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This crude-oil pumping station, now completely modernized, can serve as a model of efficiency to the industry. In this station, as in many other oil or gas pumping stations throughout the United States, Pacific-Western gear units provide unfaltering service.

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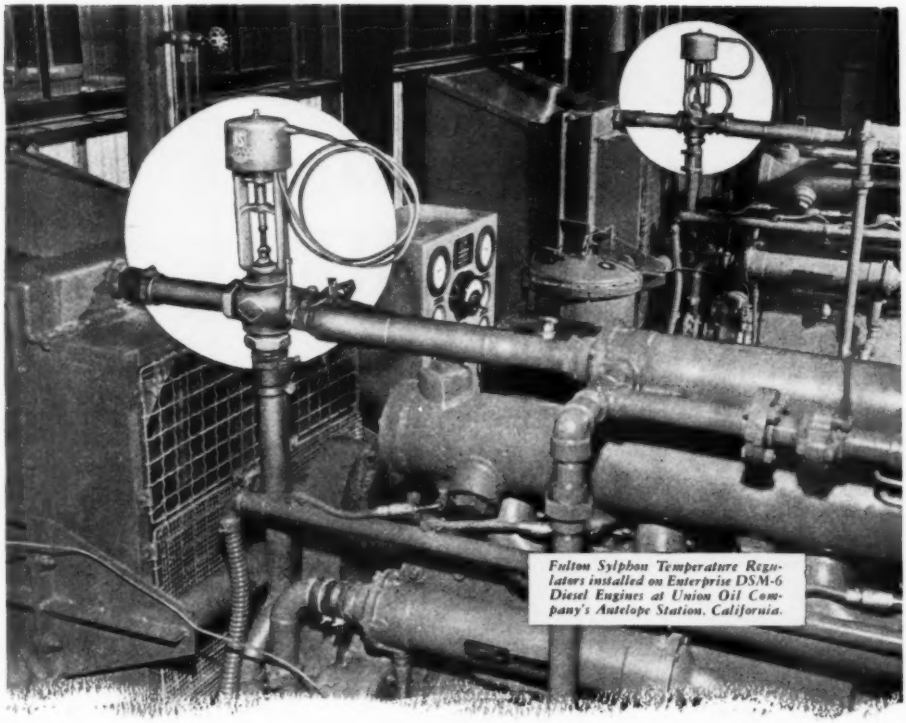

Fulton Sylphon Temperature Regulators installed on Enterprise DSM-6 Diesel Engines at Union Oil Company's Antelope Station, California.

NEW PUMPING STATION RUNS ON ITS OWN CRUDE!

Sylphon Temperature Regulators help in operation that cuts fuel consumption 90%!

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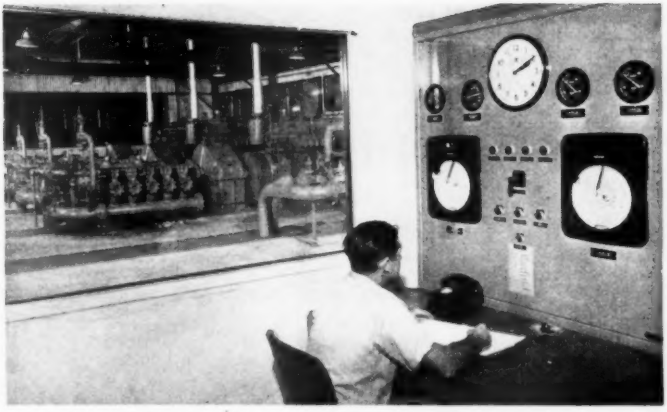
When heating of incoming crude oil is required, oil is bypassed through this oil-fired heater at rate of 600 bbl. per hour.



Instrument panel in office gives operator complete picture of station operation, including pressures and temperatures of crude oil entering and leaving station. The large window gives operator an excellent view of the three pumping units.

the line and stored in a 2,000-bbl. tank.

The crude oil for fuel use is settled in this tank and is then pumped into the 100-bbl. day tank which is located on a 10-ft. platform from where the oil gravitates to the engines (see Fig. 1). The plant was designed with a centrifuge in the line from the crude-oil tank to the day tank. However, it was decided to attempt to condition the oil for burning in the engines by filtering and settling; therefore, the centrifuge was not put in when the plant was built. From time to time trouble has been experienced in the engines from traces of water which could not be removed from the oil so a Sharples centrifuge has been installed. The oil is electrically heated to 120°-160° before centrifuging.

Starting up.—For starting an engine and until it is brought up to operating temperature, distillate fuel is used. Stored in a 500-bbl. tank the light fuel passes through a three-way valve (A in Fig. 1) to the engine. Excess light fuel flows from the fuel header to a second three-way valve (B), which is set so as to recirculate the oil through a by-pass line.

The two valves are interconnected so that switching one automatically sets the other to its correct position. Thus while set to feed light fuel to the engine, crude oil is permitted to circulate only to the engine-mounted heater. There it is heated to 180° F. by hot engine-cooling water, in preparation to being used as fuel.

Operation on crude.—Switching the two three-way valves from light to heavy oil permits the latter to flow to the engine; at the same time the flow of distillate fuel is stopped. Crude then flows through the strainer, through the engine-driven fuel pump, to an absorbent-type filter, and to the fuel header. Excess crude passes through three-way valve B and is returned to the crude-supply system just ahead of the engine-mounted heater.

So that light fuel will be in the lines for starting up, the engines are switched to distillate oil about 15 minutes before they are to be shut down.

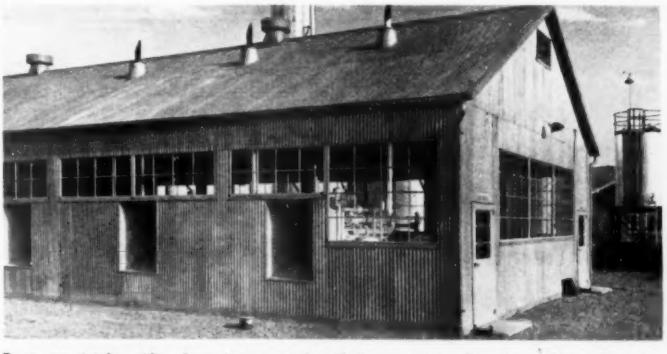
Control equipment.—During starting each engine is manually operated from an adjacent control panel, on which are temperatures and pressure gages, tachometer, exhaust pyrometer, clutch-control valve, an alarm system with indicating lights, and the manual-automatic control switch. After an engine has been switched to heavy fuel and pumping started, it is placed on automatic control. Under these conditions engine speed is governed by a diaphragm motor valve which is remotely operated by a Foxboro wide-band proportional controller.

Cooling of engine-jacket water is accomplished in a Young radiator mounted on the extended engine subbase. Water leaves the exhaust manifold at 185°-190° F. and after passing through the crude-oil heater has a temperature of about 185° F. It then passes to a Fulton Sylphon valve which automatically holds the temperature of water being returned to the radiator at 185° F.

Cooled water leaving the radiator, at 175°-180° F. passes through a lube-oil heater (or cooler) en route back to the inlet manifold. By this means the temperature of the lube oil, which is a heavy-duty, high detergent oil, is maintained at 170°-175° F. During periods of warmup the three-way Sylphon valve acts to bypass completely the radiator until the engine reaches operating temperature.

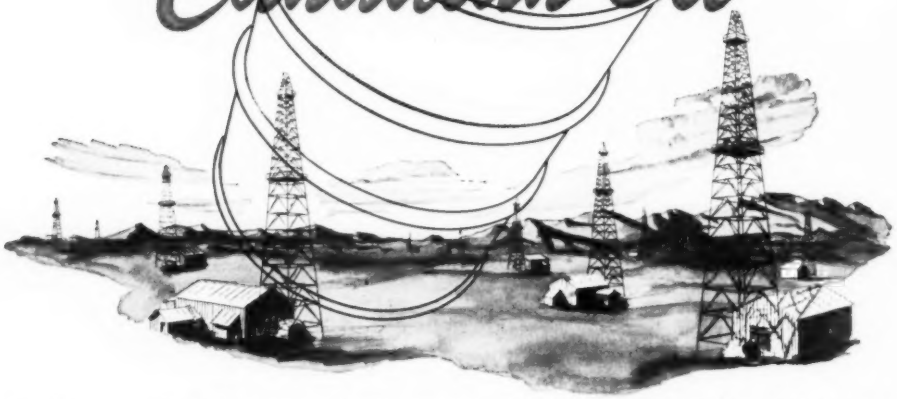
Pumping Equipment

Through Western Gear speed reducers, which have a 5.81 to 1 ratio and a A.G.M.A. Class 1 catalog rating of 553 b.hp. at 720 r.p.m., the engines drive Wilson-Snyder quintuplex, positive-displacement, single-acting 5 by 8-in. pumps. Taking suction from a common header at about 17 psi. they discharge the crude at



Ducts on intake side of engine-mounted radiators permit adequate cooling of engine jacket water.

FACTS ON THE *Barrelhead* ABOUT *Canadian Oil*



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pressures of 300 to 800 psi. depending upon pumping conditions. Each pump has a capacity of 540 bbl. per hour at 124 r.p.m.

In addition to this principal pumping equipment a Kinney motor-driven gear pump is used to circulate a portion of the incoming crude to the direct-fired heater. Through proper setting of valves this pump also can be shifted to the duty of emptying the temporary storage tanks. Rated at 600 bbl. per hour, it moves this crude from storage to the intake header of the main-line pumps.

Housed in a separate building is a motor-driven fire pump for supplying water to an overhead fog-nozzle system in the pump room. The entire system responds automatically if a fire occurs, or can be turned on manually from outside the building. In the event of power failure a similar engine-driven pump is provided as a standby.

Station Operation

The Antelope station is designed to serve either the 8-in. heavy-crude line or an 8-in. light-oil line. In normal operations, however, the light oil merely passes through the station without any boost in pressure. Therefore in Fig. 2 piping and connections for pumping the light oil are not shown.

Incoming heavy crude from the Junction station passes through strainers and to a takeoff point where a portion of the crude is removed for circulating to the direct-fired heater (see Fig. 2). Remainder of the stream, after joining hot oil from the heaters, goes to a 10-in. header from which the pumps take suction. From the pumps the crude is discharged into an 8-in. header and toward the Shandon station.

Portion of the incoming crude to be heated, 600 bbl. per hour, is picked up by the booster pump and circulated to heater where controls on the crude-oil burner automatically regulate amount of heating which takes place. The heater, of Millard design, has a rating of 6,000,000 B.t.u. per hour.

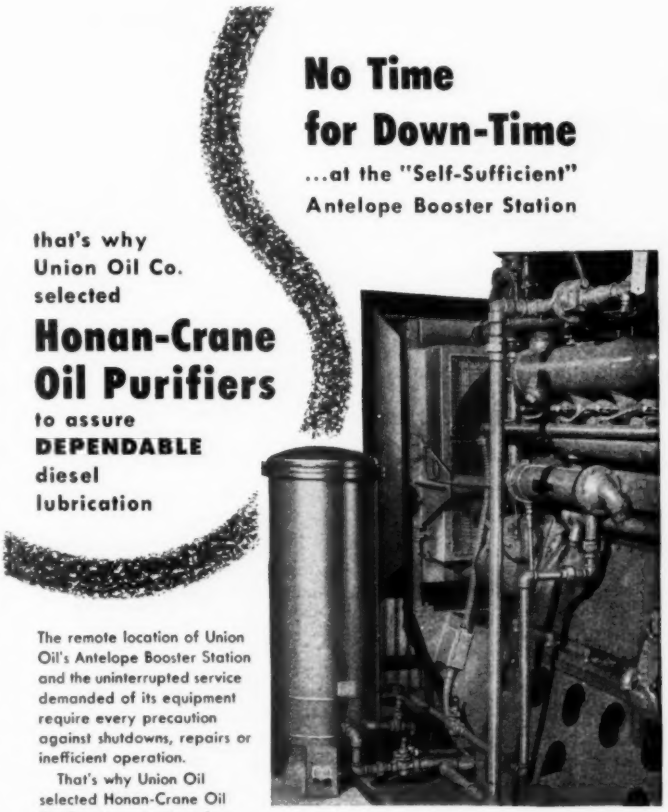
Currently no heating is required. In winter time, however, sufficient heat is added in the heater to increase the temperature of the total crude stream leaving the station to about 160° F. Incoming crude from the Junction station has a temperature of 110° to 120° F. during winter months.

Control of pumping rate is accomplished through a 60-ft. surge tower which floats on the line. In normal operation about a 50-ft. head is maintained in the tank, through the Foxboro proportional controller acting to speed up or slow down the engine speeds to hold a constant suction pressure on the station.

If for any reason the level in the tank exceeds 55 ft. or falls to 45 ft., an alarm sounds and lights flash on the control panel in the office. If the tank fills to the overflow line, crude automatically flows through a relief line to a large storage tank. If the level falls to 45 ft. the tank still contains sufficient crude for about 30 minutes' operation, during which the operator can shut down engines or take whatever steps are necessary to slow down the pumping rate in accordance with the volume being received.

Should the line pressure leaving the station exceed 800 psi. for any reason, a Fisher pressure controller in the discharge line is actuated. This controller removes oil from the system to the relief tank. When the Fisher controller operates it activates the alarm system which sounds the horn and lights a light on the control panel in the office.

As a result of the successful operation of its Antelope station, Union shortly will begin modernizing its Junction station. There steam equipment will be replaced with six Enterprise crude-burning diesels. In addition, because of the operating economy offered by the engines in comparison to the old steam equipment eventually the company plans to install similar equipment in all stations on these lines.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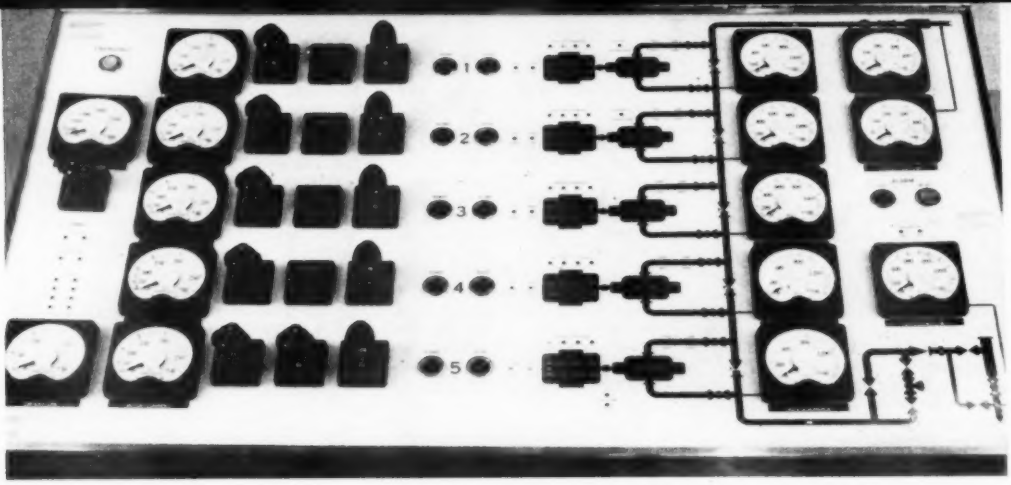


Closeup of new control-desk top. Baton Rouge 18-in. line.

NEW

Electrical Pressure Instrumentation

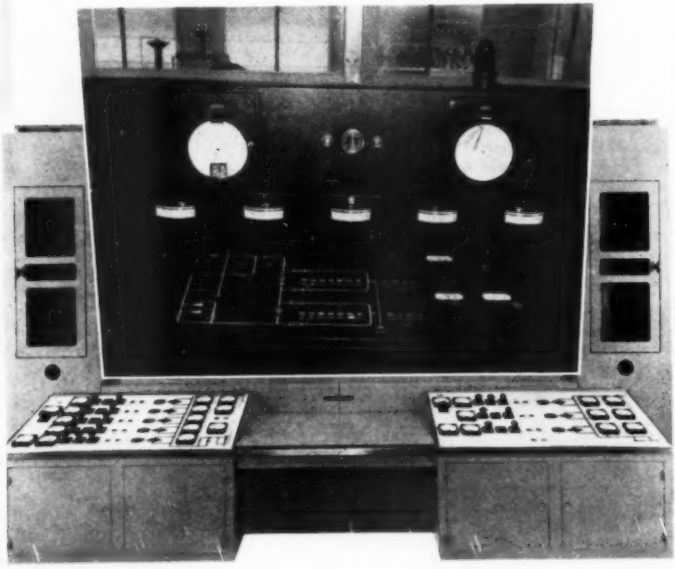
on Plantation Pipe-Line System

While initial cost is higher, the author believes that fast payout will be realized by using this new type of instrumentation due to more accuracy over a long period.

by M. J. Dabney

PLANTATION PIPE LINE CO. will use new-type electrical pressure-indicating instruments in the pumping stations involved in its present expansion program. These instruments utilize the Baldwin SR-4 strain-gage pressure cell as an electrical pressure pickup with electrical meters graduated in pound per square inch as pressure-indicating meters. The strain-gage pressure cell will also be used as a pressure-pickup source for operation of the station pressure-control instruments. Flow-control and flow-recording instruments will obtain their intelligence from a differential-pressure strain-gage cell connected across the orifice on the discharge side of each station.

Electric pressure instruments of this type, particularly the electrical pressure-indicating system, are new and a rather radical departure from the conventional bourdon type of instrumentation normally used in crude and product pumping stations. Development of the electrical pressure-indicating instruments described here is the result of a research project initiated by Plantation in January 1948. Purpose of this project was to



Baton Rouge control desk—left-hand console is for new 18-in. line; right hand for present 12-in. line. Inset shows earlier experimental control desk.

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THE AUTHOR

M. J. Dabney, technologist, Plantation Pipe Line Co., Atlanta, studied mechanical engineering at Georgia School of Technology. He was with Georgia Power Co. prior to service in the Navy in World War II, during which he was fighter-director officer. While in the Navy he studied electronics at Harvard University and Massachusetts Institute of Technology.

develop dependable electrical means for the transmission of pressures from various points on the station piping to the control room for operation of the station. A system of this type completely eliminates small fluid control piping, containing inflammable product, and therefore eliminates the potential fire hazard that exists in bringing inflammable products into a "safe area" in which nonexplosionproof electrical equipment is installed.

Properly designed electrical gages should offer higher over-all accuracy over long periods of time and require less maintenance. In addition, the problem of leakage and replacement of control piping resulting from external corrosion would be reduced to a minimum.

It has been Plantation's experience in 11 years of operation that frequent calibration of the present pressure-indicating gages against deadweight test has been necessary to provide reasonable accuracy. In products-line operation the accuracy of indicating and control pressure gages becomes an important factor when it is necessary to maintain maximum throughput. An over-reading gage on discharge or under-reading gage on suction can cause a loss in throughput, particularly when station pressures are near the upper or lower operating limits.

Experimental Installation

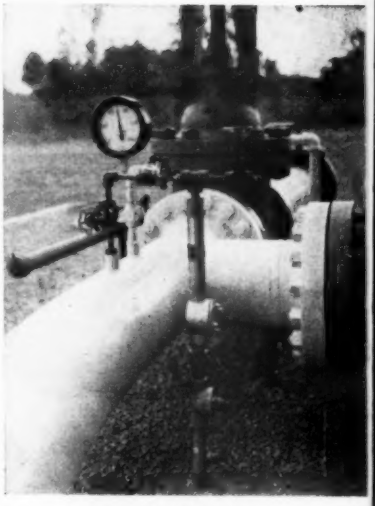
In April 1950, a complete electrical pressure gage system was installed experimentally in Plantation's Center station near Athens, Ga. This station is on the 10-in. main line and has two 6 by 8, four-stage centrifugal pumps driven by 600-hp. electric motors. Five pressure-indicating meters are required in the control room at this station to indicate station suction, pump suction, intermediate, pump discharge, and outbound line pressures. The electrical pressure-indicating system, therefore, consists of five indicating meters, a power supply, and five strain-gage pressure cells mounted at the various points on the station piping.

Application of the strain-gage pressure cells and associated circuits for this installation was designed by Baldwin Lima Hamilton Corp. and Ruge de Forest, Inc., in accordance with Plantation's specifications.

For this installation, spare conduit was available between the switchgear room and the manifold shelter and between the switchgear room and the control room for the cable runs. Junction boxes were installed under the manifold shelter, and conduit was installed to each pressure pickup point in order that continuous cable runs could be made between each pressure cell and the power supply.

The power supply is an electronic voltage-regulated rectifier which supplies direct current to the pressure cells. This power supply is located in the switchgear room and is mounted in a cabinet.

The electrical indicating meters are mounted on a gage board in the control room. These meters are 0-8 mv. full scale and are connected to the output of the strain-gage bridges in the cells. Three controls are installed below each indicating meter. One control is an on-off switch connected so that each meter can be isolated from the remainder of the circuit. The center control is a pushbuttom which places a fixed resistance in parallel with one of the legs of the Wheatstone strain-gage bridge in the



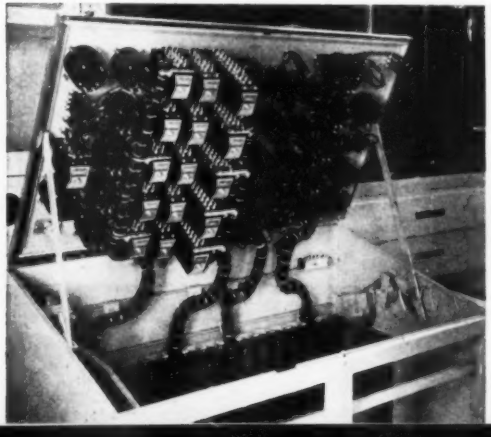
Pressure pickup installation.

pressure cell. By placing this resistance in the circuit, the bridge is unbalanced by a fixed value corresponding to a certain pressure which is red-lined on the instrument scale. The right-hand control is a potentiometer to bring the needle to the red line to calibrate. Output of the cell is linear with respect to pressure and it is only necessary to calibrate at one point on the scale. On this first installation, the pressure cell is included in the calibration circuit and it is necessary to remove the pressure during calibration.

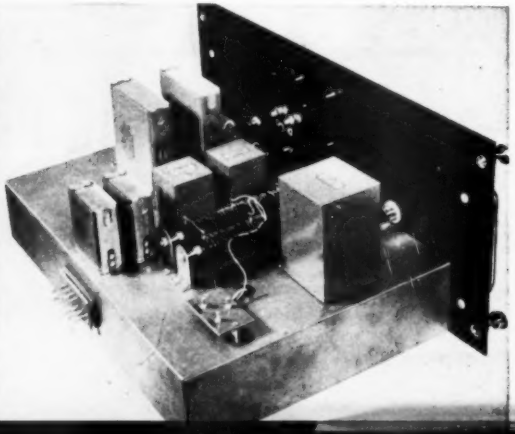
One of the Baldwin SR-4 strain gage pressure cells is mounted on the outbound line at Center station. The valving is so arranged to allow the pressure to be removed from the cell during calibration. If desired, a deadweight test can also be applied to the cell without removing it from the line. Conduit connections are made to the opposite end of the cell.

The pressure cell itself is a hermetically sealed steel shell on the

Under side of control-desk top.



Chassis of main power-supply unit.



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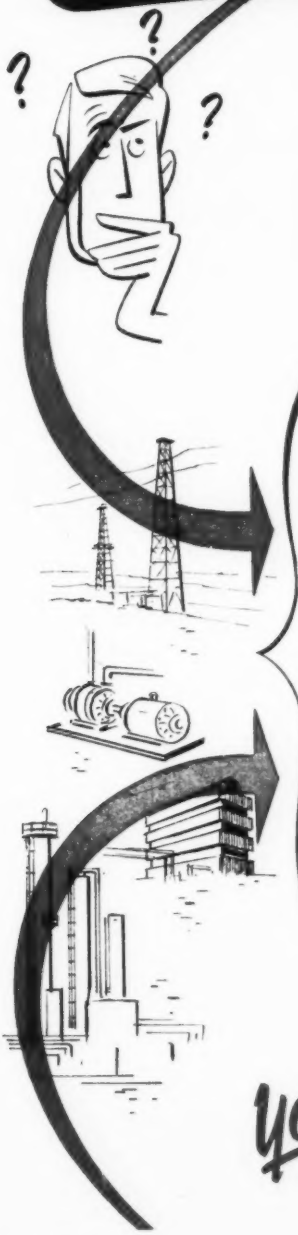

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inside of which is a pressure-sensitive tube. Bonded to the outside of this tube are resistance wire strain-gages connected in the form of a Wheatstone bridge. The product whose pressure is to be measured enters the tube, causing it to expand and stretch the strain-gage wire and thus increase its electrical resistance. The increase in resistance results in a bridge unbalance which is directly proportional to pressure, thus enabling the indicating meter to be calibrated in pounds per square inch.

Foxboro pneumatic pressure transmitters (for suction and for discharge) are used in the system. They also use the Baldwin SR-4 pressure cell as a pressure pickup. The electrical pressure intelligence from the cells is converted to control air pressure to operate the pen arms in the Foxboro controller in the control room. The control instrument in turn controls the station on low suction and high discharge of the conventional manner.

This experimental installation has been in operation for approximately a year and a half. Total maintenance costs during this period have been the replacement of vacuum tubes in the power supplies, which amounts to less than $15. On a recent deadweight test, the accuracy of the system was found to be well under 1 per cent. Complete calibration is handled as desired or needed by station personnel. The above vacuum-tube replacement costs are negligible compared to the frequent deadweight calibrations required by the conventional pressure gages, which must be performed by division office personnel. With the exception of the needle in the indicating meter, there are no moving parts in the entire pressure-indicating system.

New System

The favorable performance of the experimental installation of this equipment at Center station led to its incorporation in the design of the new stations in the present expansion program. Certain changes and improvements were considered desirable in the simplification of the system for operating convenience and for adapting to the new station design.

This system differs from the original system mainly in that its operation is a.c. instead of d.c. This change enables elimination of all vacuum tubes in the main power supply and allows use of a more rugged type of indicating meter. One individual amplifier, however, is necessary on the output of each pressure cell to drive the meter.

The power console is divided into four sections. The bottom section or juncture unit contains terminal block connections for the four-conductor shielded cables from the pressure cells, the 115-volt a.c. main power for the system and terminal block for the two-conductor cables to the indicating meters.

The next section of drawer-type plug-in construction is the main power supply. It supplies all of the pressure cells with the proper a.c. input voltage and contains selenium rectifiers and filter circuit for supplying the individual amplifiers with d.c. plate voltage, etc.

The third section is a storage unit for storing spare tubes and one spare amplifier. The top section contains an amplifier for each pressure cell. These units are also of plug-in construction held in position by captive screws. All amplifiers are interchangeable.

On the front of each amplifier are three controls and a selector switch. The Res. Bal. (resistance balance) and Cap. Bal. (capacity balance) are for setting the zero of the pressure channel and for balancing out any in-phase and out-of-phase signal voltages present with no pressure on the cell in the "operate" position. The Cal. Adj. (calibrate adjust) is set with deadweight calibration so that when the selector switch is thrown to "calibrate" position, an electrical signal is produced which is identical to that produced by a pressure of 0.70 of rated capacity of the pressure cell.

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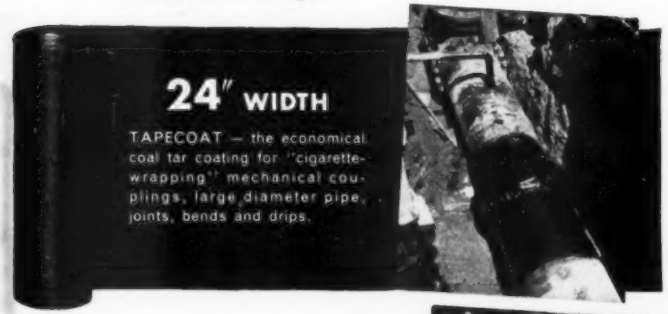

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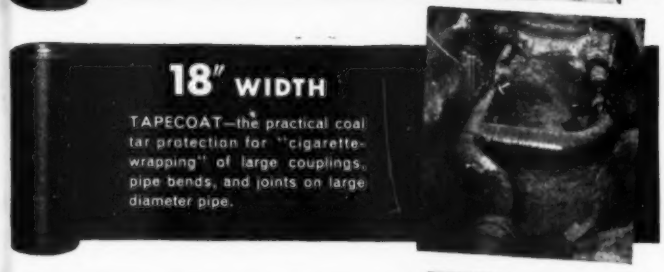
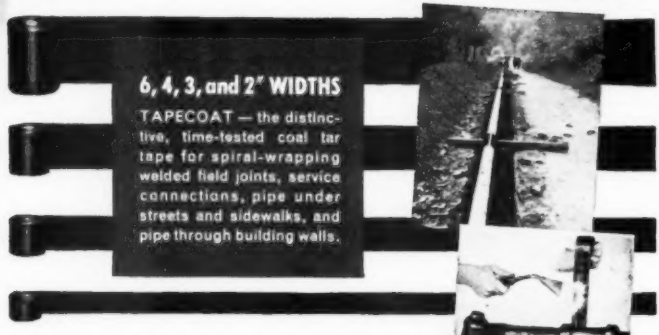


18" WIDTH

TAPECOAT—the practical coal tar protection for "cigarette-wrapping" of large couplings, pipe bends, and joints on large diameter pipe.



6, 4, 3, and 2" WIDTHS

TAPECOAT — the distinctive, time-tested coal tar tape for spiral-wrapping welded field joints, service connections, pipe under streets and sidewalks, and pipe through building walls.

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red-lined at 0.70 of its scale for calibration. Just inside the control desk, a calibration strip is provided which contains a potentiometer for each meter. The potentiometer is used to bring the needle to the red line, if required, to complete calibration. It is not necessary with this system to remove pressure from the cell in order to calibrate. The zero position of the selector switch is used when it is desired to set or check the mechanical zero of the pressure indicating meter.

Grouped Meters

The left-hand half of the control-desk console which will be used at Baton Rouge station will control the new 18-in. line. The present 12-in. line will be controlled from the right-hand desk. Pressure and flow-control instruments for each line will be mounted in the vertical panels. It will be noted that the electrical pressure - indicating meters are mounted in the face of the desk and are designed to fit into the schematic piping layout for the station. Each meter is labeled with a name plate and has a line to the point on the station piping from which the pressure is taken. It will also be noted that the meters are of the same design as the voltage and current meters on the left side of the desk. Mounting the meters in this manner provides compactness and grouping for ease of operation and also allows an unobstructed view of the pump room.

Pressure - indicating meters are standard 5-volt a.c. rectifier voltmeters with scales graduated in terms of pressure. Each is connected to the output of its individual amplifier. Pressure control of the stations will be accomplished with Foxboro instruments (as described above for Center station) which also use the Baldwin SR-4 pressure cell as the source of pressure intelligence.

Baton Rouge and Bremen, the input stations for the 18, 12, 14, and 10-in. lines, will control on flow in addition to pressure control. The remaining stations will control on pressure and have flow recorders only. All flow controllers and flow recorders will operate from the electric strain-gage differential-pressure cell.

Initial cost of electrical pressure-indicating equipment is considerably higher than the conventional types which use fluid-control piping. It is believed, however, that a fast payout will be realized by the use of this type of instrumentation due to increased accuracy over long periods of time. Contributing to this are lower maintenance costs, elimination of need for division personnel to make frequent deadweight calbrations, elimination of corrosion leaks and fitting leaks, and elimination of a constant potential fire hazard when inflammable product is brought into the control room.

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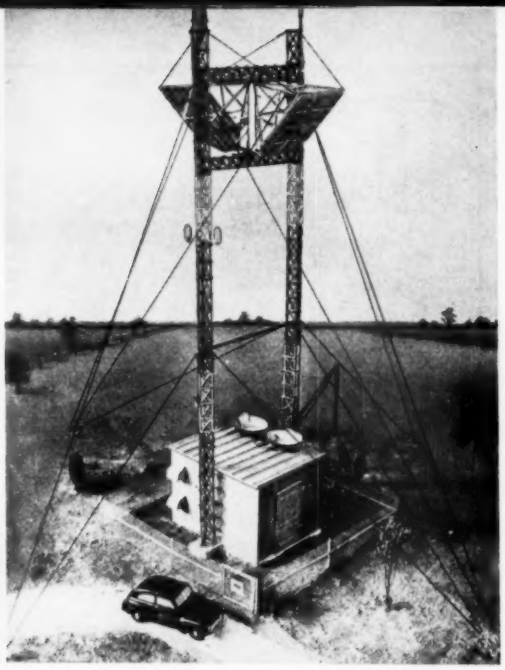
Repeater station of Keystone Pipe Line Co. microwave system. (Courtesy, Federal Telephone & Radio Corp.)



Microwave repeater station with VHF passive reflectors. (Courtesy, Tower Construction Co.)

Microwave Radio—Does It Pay?

Where a company has sufficient communication requirements or two or more companies can pool their individual requirements, then privately owned pipe-line microwave radio is a "Grade A" bargain. And management should not underestimate the savings that automatic supervisory control and telemetering functions can provide.

by F. Vinton Long

ESTIMATES of the advantages of microwave communication links for pipe lines are sometimes optimistic as to the actual installation costs involved, and the out-of-pocket plus fixed-charges annual operating costs which must be considered by pipe-line management. Many of the discussions on the subject apparently base their figures on microwave equipment alone, ignoring the fact that this item usually represents less than half the total installed cost.

From management's point of view, the question of adequate pipe line communications can be resolved into several hypothetical conditions which if considered in proper sequence will almost automatically bring to light the recommended type of pipe-line communication. These conditions are:

A. Adequate communication can be obtained by means of existing public telephone facilities, such as the local telephone companies in the areas involved.

B. There is sufficient traffic and/or traffic of an urgent nature such as dispatching operations which indicate the need of one or more private communication channels extending along the pipe-line route.

If condition (B) exists, as is usually the case, the requirement will usually be in one of these categories:

1. One private full-time talking circuit with no telemetering and/or supervisory control functions will be adequate now and for the next 3 years.

2. One private full-time talking circuit plus one telemetering and/or supervisory control circuit which can handle a limited number of functions, will be adequate now and for the next 3 years.

3. Three or more private full-time talking circuits plus one telemetering and/or supervisory control circuit which can handle a limited number of functions will be adequate now and for the next 3 years.

4. Three or more private full-time talking circuits plus one or more telemetering and/or supervisory control circuits (each of which will handle several functions) will be required now or within the next 3 years.

If pipe-line-communication requirements are met by conditions (A), categories (1) or (2), it will be more economical to lease facilities from a common carrier than to operate a privately owned microwave system. Category (3) will seldom be encountered and is not recommended as it would be more economical to lease circuits under conditions of categories (1) or (2) for vital communication, and use regular common-carrier long-distance toll telephone facilities for overflow traffic.

There may be other considerations, such as continuity of service and a need for the company to fully control its own communication facilities, which would in effect override an apparent or paper financial saving, but unless this holds true only category (4) warrants the installation of a company owned microwave system. Because of this there will be serious

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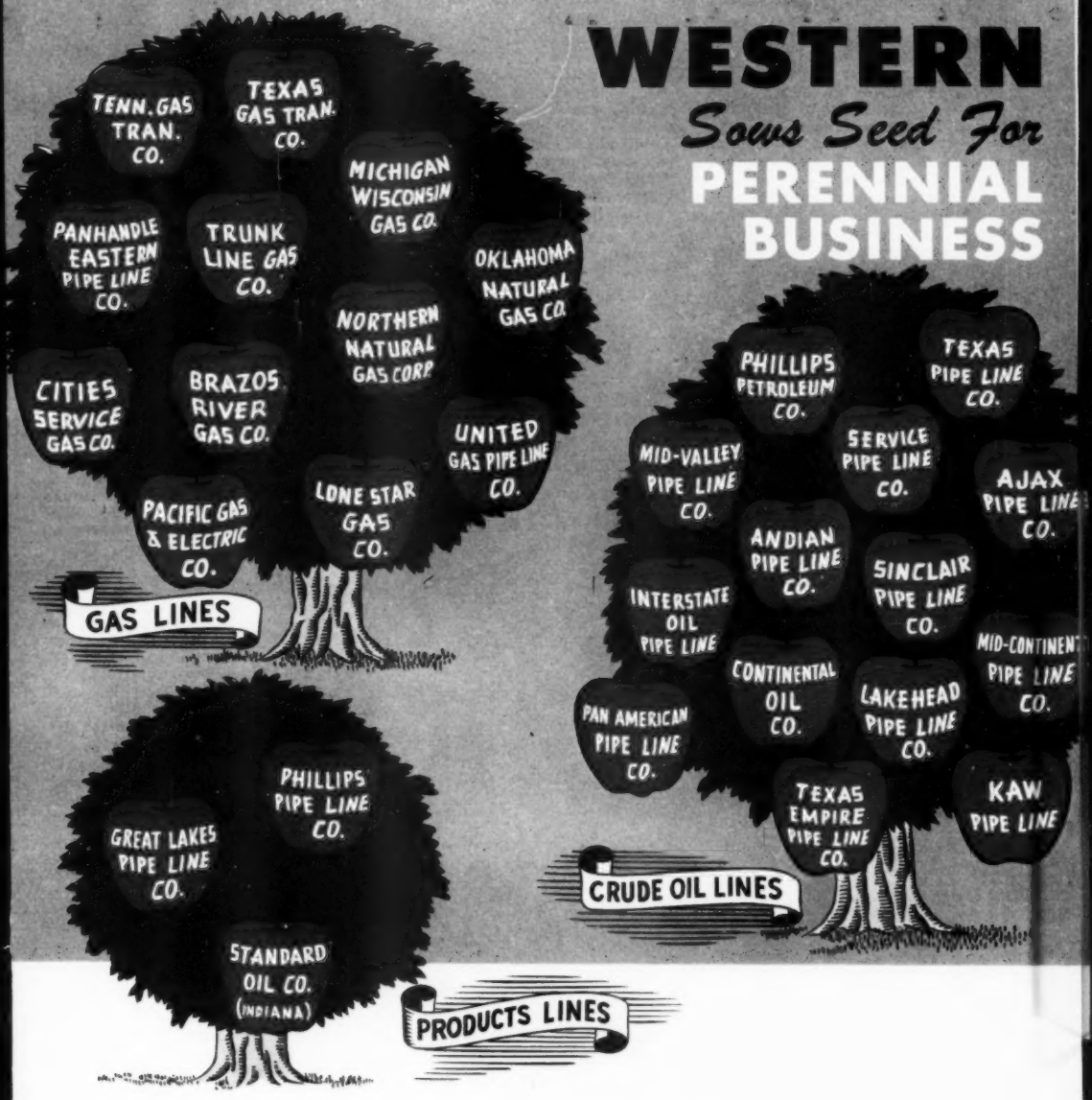

During these past five years of feverish development in gas transmission facilities we've participated very largely, both in the meeting of construction schedules on compressor station completions . . . and in the development of new cooling methods to meet demands peculiar to geographical locations.

At the same time that we were supplying this modern giant we have continued in the crude and products pipe line fields — examples — Mid-Valley and Great Lakes pipe lines. We plan to continue doing what we can to aid the petroleum industry in all phases of heat transfer equipment.

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consideration given to jointly owned or shared facilities operated on a non-profit basis. Installations of this kind would be practical only where two or more pipe lines are parallel and within 20 miles of each other for some distance.

As indicated above, the breakover point from a purely financial view would be three voice circuits, plus the first telemetering or supervisory control function that is required.

It will cost approximately $1,100 a mile to install the first voice channel of a system, assuming compressor or pump stations equipped with voice-communication facilities each 70 miles and it would cost an additional $100 per mile to expand this to eight channels. Addition of long-distance private voice circuits, provided basic multiplexing equipment is already installed, is inexpensive; a 1,000-mile circuit would cost $1,000 for each end of the link, or a total of $2,000. This would provide one desk-set telephone at each end of the line.

Assuming that microwave is indicated, either because of requirements outlined under category (4) or other reasons, then it is to the company's advantage to load it up to capacity and to make use of the extremely low additional cost per channel or function once the system is installed.

To give an indication of the rapid drop in channel mile cost as the system is loaded, Table 1 and Fig. 1 are provided. The figures, which are only approximate and vary widely depending on terrain and type and locations of facilities required, confirm the previous comments on categories (1), (3), (4), etc. The common denominator of cost per month per circuit mile is used, inasmuch as that is the usual billing method of leased-line common carriers.

Study of the annual costs involved in maintaining a microwave system bring out the fact that depreciation and fixed charges account for the greater part of the investment.

Out-of-pocket maintenance or operating costs are largely concentrated in three groups:

(a) Personnel salaries.
(b) Tube replacements.
(c) Transportation for maintenance personnel.

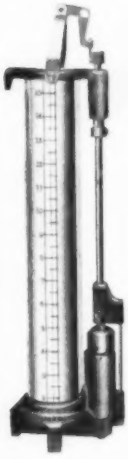
Commercial electric power and repair parts other than tubes are not important items of expense compared to those listed under (a), (b), and (c). Installation cost of a microwave system will depend more on terrain encountered on the route, and operating conditions such as spacing of pump or compressor stations, than on choice of the several leading competitive microwave equipment suppliers. The above first two factors will largely determine the number of repeater stations required for the system, and at $20,000 each the addition of several repeaters can considerably increase the system cost.

Many instances will be found in hilly or mountainous terrain where the pumping or compressor stations are down in valleys or saucers. In these cases the backbone or through microwave link will be confined to hill tops or other high points in elevation, and side hops run down to

(Continued on page 223)

THE AUTHOR

F. Vinton Long, project engineer, Texas Eastern Transmission Corp., Shreveport, is in charge of design and construction of the company's 1,400-mile microwave system extending from Shreveport to Linden, N. J. For 6 years he was in and out of Latin America with Pan American Airways. For 7 years he was communications superintendent for Mene Grande Oil Co. in Venezuela. For 3 years he was with Army Airways Communication System as operations and planning officer. He was airways engineer for Westinghouse Electric International Co., New York, for 1 year. He has been responsible for installation of communication nets for the Turkish State Airways in Turkey, and for the oil industry in South America.



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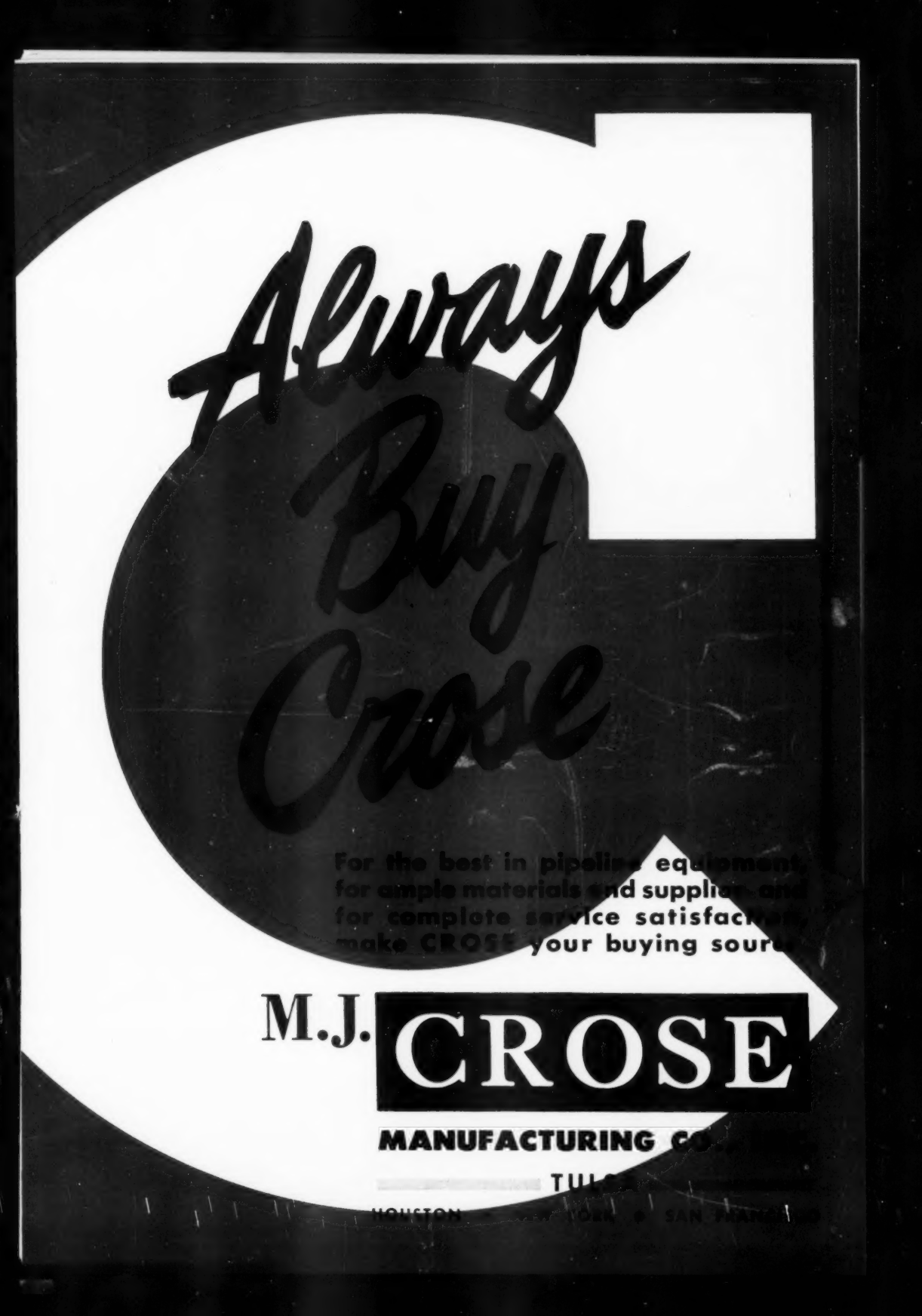
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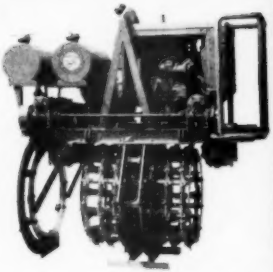
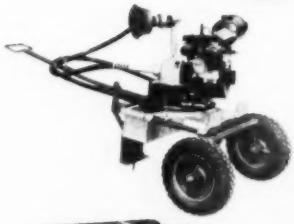


MODEL "K" PIPE CLEANING AND PRIMING MACHINE
pipe
ter. May be used line-traveling or on stationary base. This machine is also available for larger pipe sizes.



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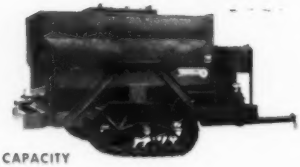
utility unit for operating wire brushes, buffers and cleaning bevels. May be used as utility light plant.

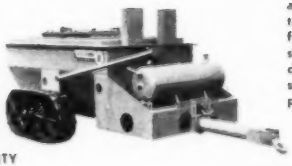


CROSE-LITTLEFORD PIPE COATING KETTLES are equipped with hydraulically controlled agitator, low pressure burner, dial-type thermometer and a Wisconsin air-cooled gasoline engine with electric starter. If the agitator becomes fouled, the hydraulic fluid by-passes until the agitator is freed. The low pressure burner uses any type of low-grade fuel oil and distributes heat equally over all parts of the bottom. This burner is designed to avoid hot spots thereby eliminating the necessity of replacing bottoms. These completely insulated kettles may be purchased on Athey tracks or on skids for stationary coating yards. Over 150 of these kettles are in service in the United States and Canada.

0 BARREL CAPACITY

BARREL CAPACITY

CROSE-LI ORD PIPE COATING KETTLES are equipp with manually operated agitator, two N burners and can be furnished mount on Athey tracks or skids. This kettle a available with hydraulically controlled a and Wisconsin air-cooled engine. This has been proven in field service.



10 BARR CAPACITY

CROSE COATING STRAINERS fit all makes of pipeline coating
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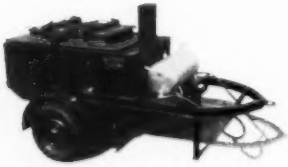
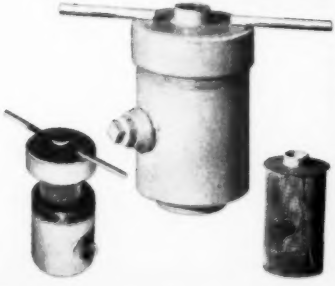
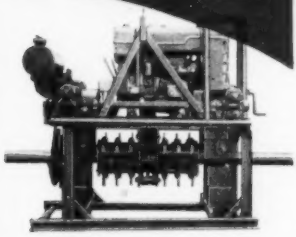
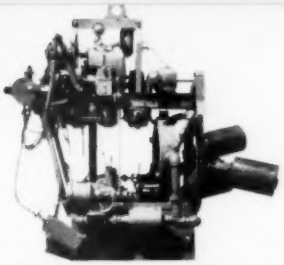
225 GALLON KETTLE is equipped with manual agitator. Available as illustrated or on steel wheels. These units are now being used for trench work and maintenance on pipelines. This unit also available in 165 gallon capacity.







MODEL "M" PIPE CLEANING AND PRIMING MACHINE can be set up to clean and prime pipe from 2" to 14" in diameter. May be used as a line-traveling machine or on a stationary base [illegible] yard work.



CROSE PIPE COATING AND WRAPPING MACHINE. Positive application of coating through our patented coating spray ring gives these advantages: 1. Coats bends as well as straight pipe. 2. Applies coating to pipe that has been "egged" or bent out of shape. 3. Reduces patches on bends to absolute minimum.

The 2"-6" Crose [illegible] coating and wrapping machine illustrated is light weight and compactly designed. These features are extremely essential for proper coating of small diameter pipe. Equipped with the patented Crose coating spray ring.

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CROSE leadership has been built on that dependability.

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CROSE ENDLESS PIPE [illegible] SLINGS are stronger and lighter in weight than conventional pipe belt slings. No bolts or steel strapping necessary. These pipe belt slings are available for pipe sizes from 12" [illegible]

CROSE PIPE CRADLES [illegible] pipe sizes from 4" to [illegible] diameter. Cradle illustrated can be adjusted to [illegible] pipe from [illegible] diameter.

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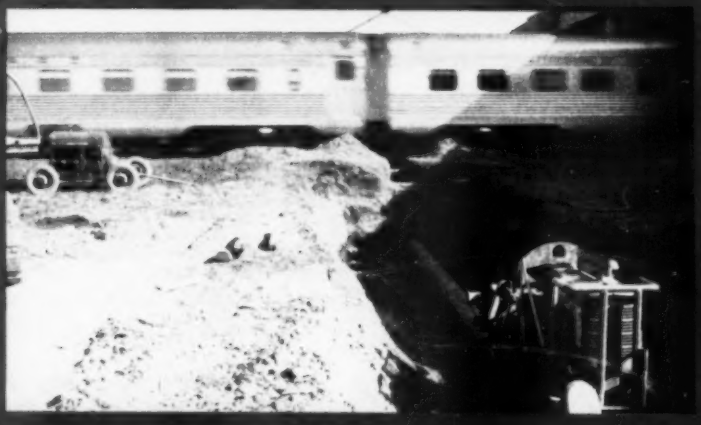
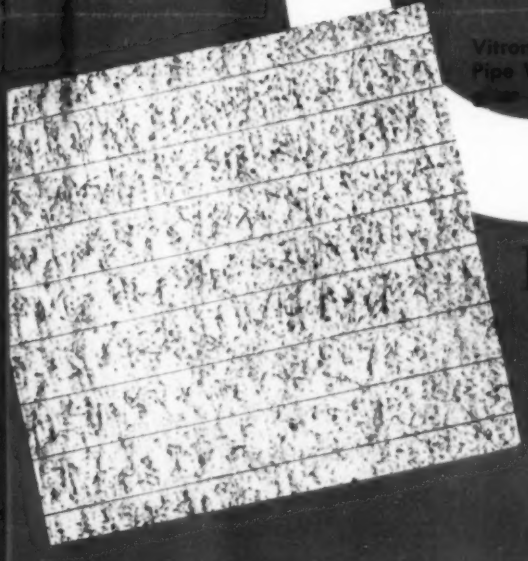


CROSE Auger-Type [illegible] BORING MACHINE installs pipe casing up to and including 34" in diameter. This machine has proven highly satisfactory, and Pipeline Contractors use it for the fastest method of installing pipe casing where rock is not encountered. Machines for installing casing larger than 34" in diameter are also available.



Vitron Glass Fiber Underground Pipe Wrap with the new parallel glass fiber reinforcement.

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the pumping stations concerned. Each of these side hops will represent an additional investment of $15,000 to $20,000.

It will be seen that there is no economic advantage of microwave unless a multiplicity of circuits is required. Comments on the operating conditions shown in category (3) indicated that it is uneconomical to lease more than one full-time private voice circuit from a common carrier. First thought would indicate that there are few instances where the traffic load would justify the use of pipe-line microwave and this is true except for one thing—telemetering and supervisory control.

It is believed that the importance of these functions, which can be carried out economically through multichannel privately owned microwave systems, will soon overshadow the value of voice circuits.

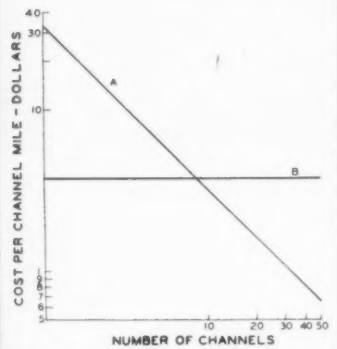

Fig. 1—Graphic relation: number of channels to cost per channel mile.

TABLE 1—ANNUAL OPERATING COST, TYPICAL 1,000-MILE MICROWAVE SYSTEM, 6 TO 10 CHANNELS

Installation cost:		
1,000 miles at $1,200 per mile		$1,200,000
Fixed charges: 20 per cent (Include interest, insurance, depreciation), 20 per cent of $1,200,000		$240,000
Maintenance, operating cost—Out of pocket:		
Personnel	$60,000	
Tube replacement	40,000	
Transportation	20,000	
All other	30,000	150,000
Total annual cost		$390,000

Circuit mile cost:

1 Channel: $390,000 ÷ 1,000 (miles) = $390 per channel mile per year or $390 ÷ 12 = $32.50 per channel mile per month.

4 Channels: $32.50 ÷ 4 or $8.13 per channel mile per month.

8 Channels: $32.50 ÷ 8 or $4.06 per channel mile per month.

10 Channels: $32.50 ÷ 10 or $3.25 per channel mile per month.

20 Channels: $32.50 ÷ 20 or $1.62 per channel mile per month.

50 Channels: $32.50 ÷ 50 or $0.65 per channel mile per month.

Note: The 20 and 50 channel figures do not reflect any additional yearly operational cost nor the initial installation cost of telemetering equipment.

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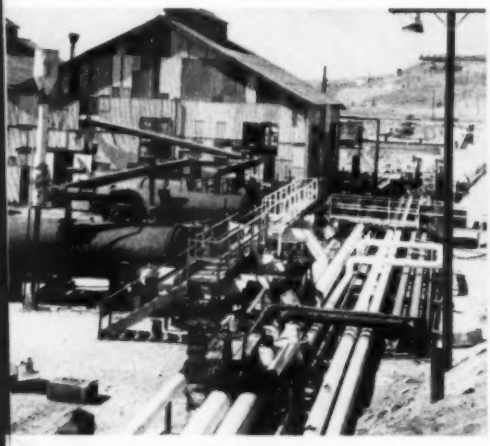
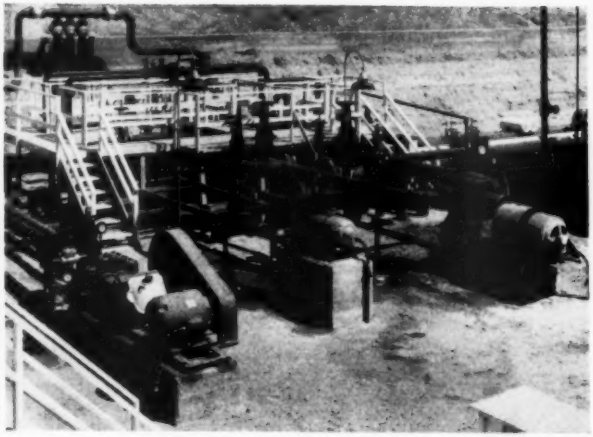


View of General Petroleum Corp.'s San Ardo station prior to its completion. Crude-oil heaters may be seen center left.



Pumping equipment for processing crude oil at San Ardo station. Unit at left moves cutter stock to lease shipping tanks for blending with crude oil. Pump in center is used for crude-oil blending at station.

How to Make Viscous Liquids Flow

Heavy, viscous nature of San Ardo crude necessitates unusual steps in getting it to terminal. Here's how General Petroleum gets the job done

by D. H. Stormont
West Coast District Editor

AN unusual heating and blending operation is being performed by General Petroleum Corp. at its recently completed 42-mile line from San Ardo field to a tank-loading terminal on the coast of California. Both steps are necessitated by the heavy, viscous nature of the crude oil being transferred.

Gas oil for blending stock is brought to the terminal, at Estero Bay, and pumped through a 4-in. line to the Monterey County field. There it is blended with the crude oil in either three or four steps. The lightened crude oil heated to a temperature of about 180° F., is then pumped through an 8-in. line to the seaside terminal. Two intermediate stations are required for reheating and boosting the pressure of the blended crude oil during its short trip.

When discharged from the San Ardo station the blended crude oil contains about 16 per cent gas oil. Thus for every 5 bbl. of raw crude oil shipped about 1 bbl. of gas oil must be piped to the field. Because of the expense of transporting this cutter stock to the field, it follows almost without saying that only sufficient gas oil is added to insure that the blend can be readily pumped.

Shipping battery on a Jergins Oil Co. lease. Here crude oil, heated to 180° F., is cut about 10 per cent with gas oil. Cutter stock flows by gravity from the 500-bbl. tank in foreground to a motor-driven transfer pump.

Field blending and heating.—Currently about 10,000 bbl. of crude oil is being produced daily at San Ardo. Of this production almost 9,000 bbl. is from the 2,100-ft. Lombardi zone, with the remainder coming from the 2,500-ft. Aurignac pay. In Table 1 are given some of the properties of these two crude oils, and of an average blend as it leaves the San Ardo station.

Preparation of the crude oil for shipment is started at the shipping batteries of the field's three operators, The Texas Co., Jergins Oil Co., and Superior Oil Co. At six of these batteries (four Texas and two Jergins), both heating and blending are performed. At these points the crude oil is heated by steam coils placed

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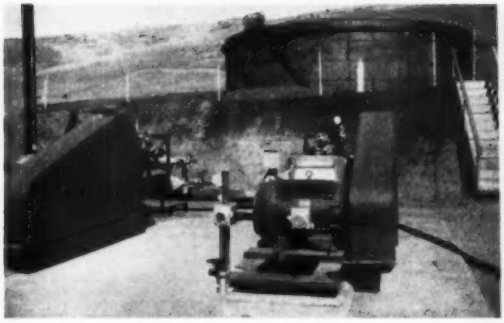
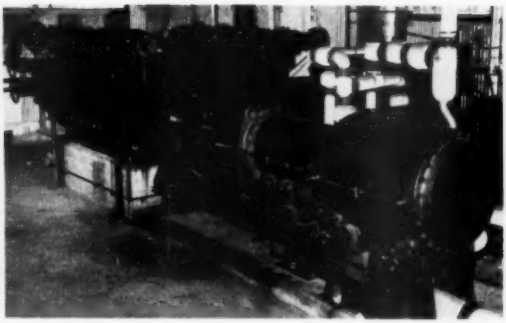


Portion of pumping and storage facilities at Estero Bay, terminus of 42-mile line.



Main-line pump at San Ardo station. This unit first placed in pipeline service in 1913.

TABLE 1—PROPERTIES OF PRODUCED AND BLENDED SAN ARDO CRUDE OIL

	Lombardi zone	Aurignac zone	Blended crude
Gravity, °A.P.I.	11.8	13.4	14.4
Viscosity, S.s.f. at 122° F.	1,021	369	170
Flash point (P.M. c.c.), °F.	176	162	166
Pour point, °F.	35	20	5
Mud and b.s., per cent by volume	1	1	0.1

in the shipping tanks, from which it gravitates to the suction of motor-driven transfer pumps. About 10 per cent of gas oil is added at this point. The light oil being introduced on the suction side of the pump becomes sufficiently mixed with the crude in the pump cylinders.

The 31°-gravity virgin gas oil is stored in 500-bbl. tanks and gravitates to the pumps. No attempt is made to regulate closely the amount of cutter stock blended with the crude. However, about 500 bbl. generally is blended with every three 1,600-bbl. tanks shipped.

If heat alone is employed at a battery, temperature of the crude oil is raised to about 180° F. through steam-coil heating. In some instances, principally at batteries where no pumping is done, the oil also is heated in transit by means of 1½-in. steam lines inside 4-in. flow lines.

Processing for shipment.—The system for gathering the heated, and lightened, crude oil consists of six 6-in. feeder lines and an 8-in. main line which bring the crude to either of two 10,000-bbl. gathering tanks. Coils placed in the tanks permit the crude to be maintained at a temperature of about 160° F., with the heat being supplied by exhaust steam from the station's low-pressure system.

After a tank is filled, the crude oil is transferred to either of two 55,000-bbl. working and shipping tanks. During this transfer sufficient gas oil to bring gravity up to about 13.5° A.P.I. is injected at the suction side of the pump, which is a 75-hp. motor-driven gear pump of 35,000-bbl. daily capacity.

Control of gravity at this stage is attained through periodic sampling of the crude oil through a bleeder on the pump's discharge. The amount of cutter stock being added is set by a recording flow controller on the light-oil line; adjustments in the amount added are made in accordance with the gravity of the crude as revealed by sampling.

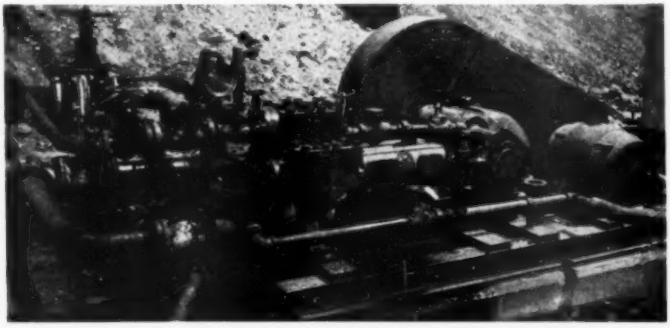
As one of the 55,000-bbl. tanks is being shipped the other is being filled, and its contents further prepared for shipping. This processing consists of the crude oil being constantly circulated, heated, and further blended with cutter stock. The crude oil flows through an 18-in. line to a shell-and-tube heater heated by exhaust steam. It is then picked up by the circulating pump (of 1,000-bbl.-hourly capacity) and returned to the tank through a 10-in. line. En route to the tank the crude oil is again lightened with gas oil.

During this phase, control is on a viscosity basis so that the crude oil can be brought to approximate shipping requirements. Accordingly as the crude oil is being circulated its viscosity is constantly being observed on a recording viscosity meter. Sufficient cutter stock is added to reduce the blend's viscosity to a range of 270-290 seconds, S.f. at 122° F.

Cutter stock is introduced into the circulating system by a 7,000-bbl.-daily-capacity motor-driven pump. This pump also supplies the cutter stock blended with the crude during transfer from the 10,000-bbl. receiving tanks. The amount of cutter stock added in either stage is controlled through regulation of gate valves provided in the 4-in. gas-oil line.

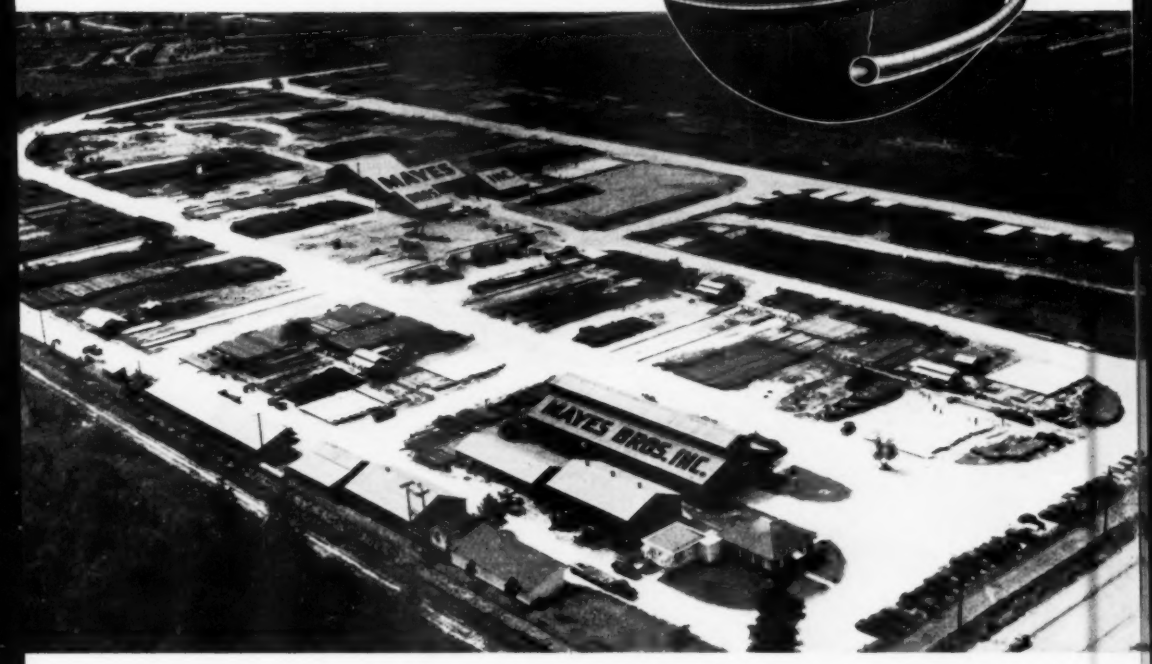
When a tank is to be shipped its connections are changed so that flow is through an 18-in. line to two shell-and-tube, two-phase heaters heated by exhaust steam at 3.5 psi. Operating in parallel they raise the blend to about 190° F. from an inlet temperature of about 150° F. An indicating controller on the heater outlet line automatically regulates the amount of exhaust heating-steam.

From the heaters the blend flows to the main-line pump, which is a tandem compound duplex unit rated at 30,000 bbl. daily at 800 psi. A last injection of cutter stock is made on the suction side of the pump, the amount added being dictated by a recording viscosity meter on the 8-in. discharge line. Discharged at pressures of 400 to 500 psi. the blend, with a gravity averaging about 14.4°



Transfer pump at a shipping battery. Gas oil flows to pump through 2-in. line in foreground. Gas-oil stream joins hot crude oil at pump suction connection.

56 ACRES of PIPE YARD



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A.P.I. and an average viscosity of 170 seconds (S.f. at 122° F.), then starts its 42-mile trip to Estero Bay.

Under present operations the cutter stock is being introduced into the crude-oil stream at atmospheric temperatures. Under these conditions there has been a noticeable tendency for the light oil not to mix readily with the hot, heavy crude oil. To insure this condition being remedied before cold weather arrives, a separate heater is to be installed and gas oil circulated through it prior to blending.

Plant facilities.—Steam-generating equipment consists of two 250-hp. horizontal water-tube boilers which supply steam at 175 psi. They are equipped with automatic feed-water controls, and are fired with blended crude oil. A pressure controller set at about 3.5 psi. automatically bleeds steam into the low-pressure system as crude-oil heating and other uses require. Condensate from this system and from the auxiliary system are returned to a hot well.

Cutter stock at San Ardo is stored in a 55,000-bbl. and a 15,000-bbl. tank. These two tanks, as well as the receiving, shipping, and fuel-oil tanks are equipped with remote tank-gaging instruments.

Operation of the two intermediate stations is similar to that of the initial station except that no blending is done. Heating facilities at these stations consist of four heaters operating in parallel banks of two. It is anticipated that over a year's operation blended crude will be received at these stations at temperatures ranging from 100° to 120° F., and will be discharged at 175° to 190° F. The No. 2 station, San Antonio, has a maximum discharge pressure of 850 to 900 psi.; that of the No. 3 station, Adelaida, is 400 to 500 psi.

At the Estero Bay terminus, three 80,000-bbl. tanks for blended crude oil and one 80,000-bbl. tank for incoming cutter stock are provided. Facilities for pumping the cutter stock to the field consist of two 5 by 10-in., 5,000-bbl. per day pumps.

The 8-in. line and nearly all facilities at each station previously had been in service on the company's Lebec to Mojave line. Constructed in 1913 to supply fuel oil to Santa Fe Railway's transcontinental system, the line became inactive when diesel power was adopted. In this service the facilities consisted of 53 miles of 8-in. line and four pump stations.

The job of removing and reconditioning the pipe, and of transporting it and the station facilities to their present site was started early in April. With Bechtel Corp. contracting the entire job, the line was relaid and the stations reerected in record time; first shipment of blended crude was started on June 19. While the line's exact capacity is yet to be determined, it is believed it will handle approximately 18,500 bbl. of blended crude oil daily.

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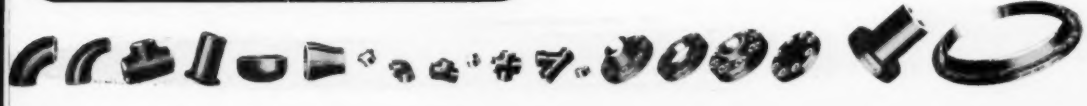

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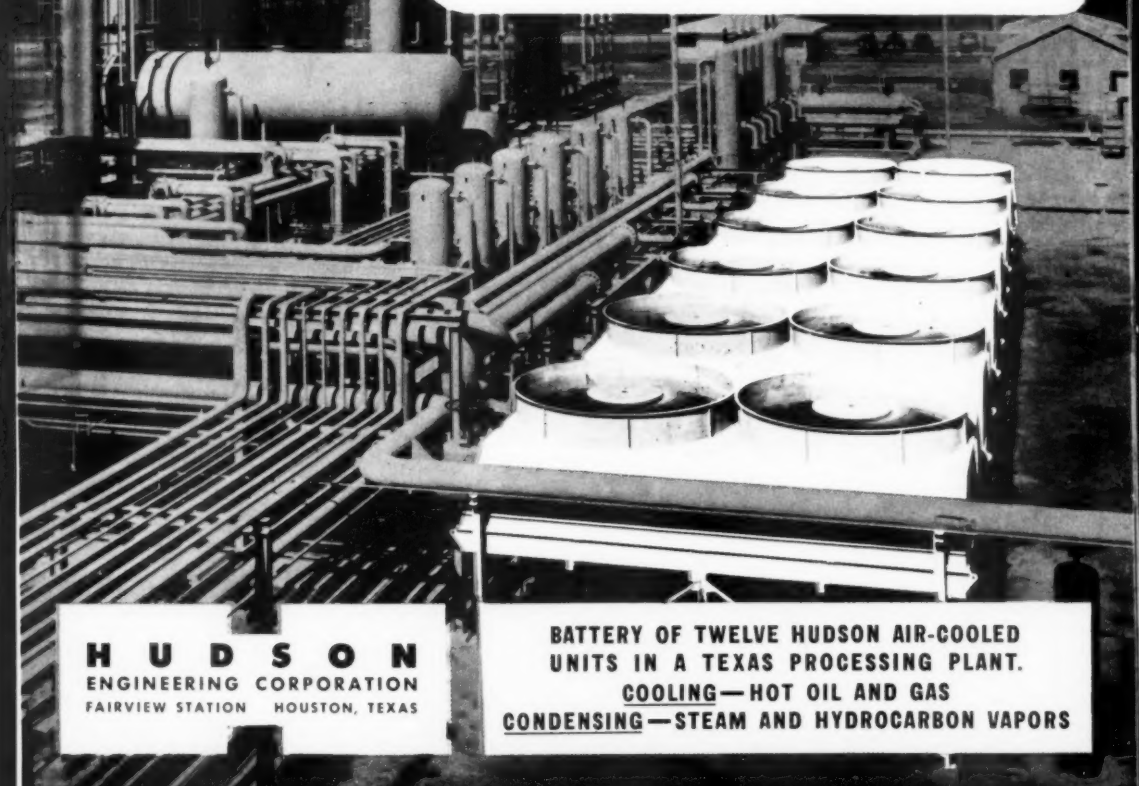

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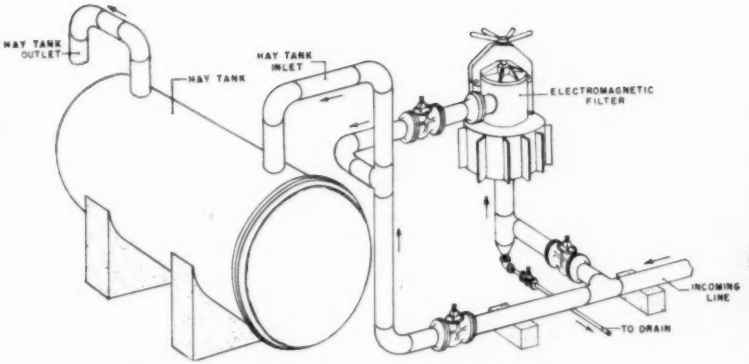
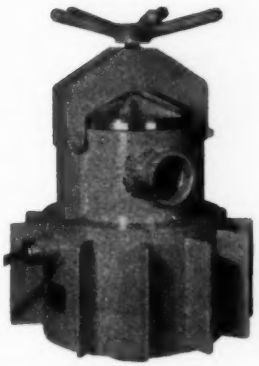
BATTERY OF TWELVE HUDSON AIR-COOLED UNITS IN A TEXAS PROCESSING PLANT.
COOLING—HOT OIL AND GAS
CONDENSING—STEAM AND HYDROCARBON VAPORS



Filtering system with electromagnetic filtering unit installed ahead of hay tank.



Electromagnetic filter unit.

New Test Data on

Magnetic Filters for Product Pipe Lines

While magnetic filters only do a partial job of filtration, they definitely are worthy of consideration on any products-line installation. Test data obtained show that they take out minute-size magnetic oxide which cause the greater damage to meter equipment. On properly inhibited lines, it is very apparent that nearly perfect meter performance can be obtained with a very small amount of supervision, expense, and maintenance at terminals and delivery takeoff points by means of a magnetic filter installed ahead of the meters and used in conjunction with a conventional type of settling tank that would reduce the stream velocity down to approximately 0.25 ft. per second maximum.

by J. G. Norton

THE object of product-pipe-line filtration is to protect expensive metering equipment from damage due to foreign matter, iron oxides, line emulsions, and water.

Some engineers are of the opinion that if a line is properly cleaned from mill scale, and if care is taken to eliminate water, and if the line is properly inhibited, the foreign matter and iron oxides are entirely eliminated. The writer, from personal observations of numerous product pipe lines, has found that this is not entirely true, and that with most well-operated and equipped lines the operating personnel are continuously seeking to improve and equip their stations, terminals, and takeoff points with filtering equipment that will more efficiently protect meter installations.

The supposition that large settling tanks, hay tanks, felt and metal cloth filters, and scraper operations on main lines can be eliminated is too idealistic and cannot be substantiated by the observations made on the majority of large product-pipe-line systems.

During the past few years there have been very definite improvements on various types of filtering equipment, which are available to the industry, but no single piece of equipment has been designed to date which will eliminate the multiplicity of units which we are forced to use to do a good job of filtering to protect metering equipment.

Good filtration of products is quite expensive, from both the equipment costs and from operating complications involved. Even with the best of equipment and supervision, some foreign matter and rouge of micron-size particles pass through the various types of filters and causes meter wear.

The internal condition of lines from refineries to starting terminals of main lines varies sometimes on account of the complicated piping arrangements, and, as a consequence, some are practically free from foreign matter and rouge while others give considerable trouble in handling the various products which are received at the terminals.

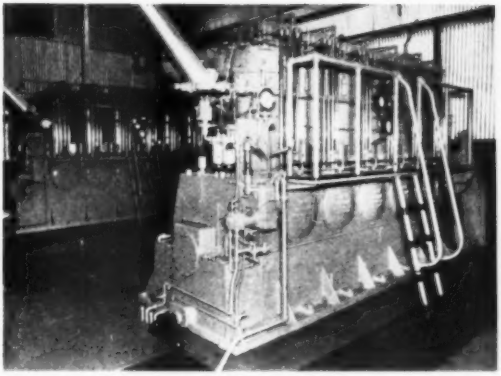
Data collected from lines (which for one reason or another cannot be kept free from iron oxide by inhibitors or other means) show that approximately 75 per cent of the iron oxide is nonmagnetic Fe_2O3 (red) and the other 25 per cent is magnetic Fe_3O4 (black). Original mill scale is black and is of the magnetic type of iron oxide, but due to weathering in the field before the pipe is laid, the mill scale through atmospheric corrosion, appears to assume the proportions of about 50 per cent ferric oxide, (Fe_2O3), which is nonmagnetic and 50 per cent ferrosoferric oxide (Fe_3O4), which is magnetic.

Nonmagnetic oxides and some foreign matter that pass filters in the form of rouge apparently are not too harmful to meter operation. Magnetic oxides in rouge form are definitely harmful to meter operation because of their abrasive characteristics.

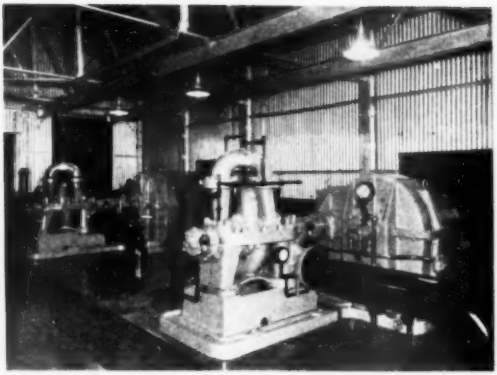
(Continued on page 238)

THE AUTHOR

J. G. NORTON
Chief engineer, Magnolia Pipe Line Co.



Each of four stations on Pan American Pipe Line Co.'s line from East Texas area to Texas City is equipped with two 400-hp. diesel engines.



Pump room at San Jacinto station. Similar equipment is installed in three other stations on the 12-in., 200-mile crude-oil line terminating at Texas City.

Diesels Run Better on Fuel Oil

Here's why it is superior to crude oil

by J. E. Chapman and C. H. Martin

Refined fuel oil has proved to be more economical than crude oil in every respect for operating diesel engines at main-line stations of Pan American Pipe Line Co.'s 12-in. main line. Comparisons made in operating experience since 1941 indicate that not only does fuel oil cost less than crude oil taken from the line stream, but that its use also results in substantial savings in all-important items of operating and maintenance expense. Under present conditions these total altogether $1,636.33 per 400-hp. engine per year.

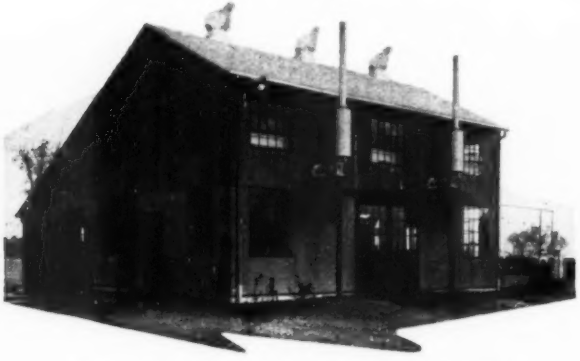
IN these times of crowded crude-oil lines when higher load factors are becoming more vital for the requirements of the industry, it is possible that the operators of other systems may find it advantageous to utilize refined fuel oil under certain conditions because of the higher transportation efficiency as well as economy which it achieves.

Some pipe-line organizations which disapproved of using refined fuel oil after investigation several years ago, may find that it is feasible today under modern conditions of better marketing and tank-truck delivery.

In fact, Pan American changed from refined fuel oil to crude oil as diesel fuel in the 1941-1945 period because of unsatisfactory conditions of delivery but reverted to refined fuel oil immediately after World War II when adequate tank-truck transportation was available.

The Pan American 200-mile, 12-in. line from the Longview-Kilgore, Tex., area to Texas City has four stations, each equipped with two Atlas Imperial, 400-hp. units (800 hp. per station). All of these engines are of the same type: six-cylinder, 13 by 16, 327 r.p.m. top speed.

During the first 6 months of operation in 1941 refined fuel oil was used. Crude oil was the fuel from July 1941 through January 1946. After a thorough investigation early in 1946, the company changed to refined fuel oil, and in the period since then, experience has shown that subsequent economies have exceeded expectations.



Pan American Pipe Line Co.'s San Jacinto station building.

Fuel-Cost Comparison

The relation between the cost of refined fuel oil and crude oil has continued much the same during the changes in market prices during the past 5 years. Deviations in this rela-

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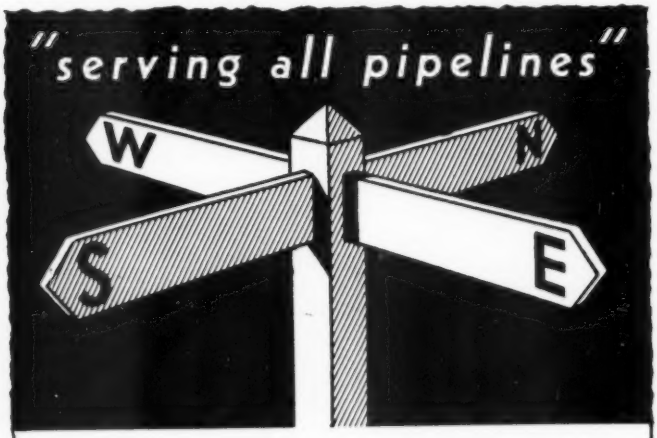
tion have been favorable to the economy of refined fuel oil because of better marketing arrangements.

An analysis of comparative fuel expense in April 1946 defines the relation between the cost of refined fuel oil and crude oil. During March 1946, the company completed a full 31-day test run on straight diesel fuel oil at the San Jacinto main-line station in order to compare fuel costs with those previously experienced when East Texas crude oil was used as diesel fuel. It was found that refined fuel oil cost $3.65 to $3.75 per day less per station than crude oil.

During November and December 1945 and January 1946, San Jacinto station pumped a monthly average of 983,250 bbl. of East Texas crude oil and 160,560 bbl. of Cayuga crude oil. The average fuel cost per month of East Texas crude amounted to $1,429.14 or $0.00125 per barrel of crude oil pumped.

In the course of the 31-day test run in March 1946, the station pumped 903,515 bbl. of East Texas crude oil and 209,875 bbl. of Cayuga crude oil. The refined fuel oil cost in this month was $1,305.37 or $0.001172 per barrel of crude oil pumped.

The net saving of $0.000078 per barrel achieved by refined fuel oil amounted to $3.75 per day for the station.



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THE AUTHORS

J. E. CHAPMAN

C. H. MARTIN

James E. Chapman, general superintendent for Pan American Pipe Line Co., started with the company in July 1941 as division mechanic, a few months after the East Texas-Texas City crude-oil trunk line was put in operation. He became master mechanic in October 1945, mechanical superintendent in January 1947, and general superintendent in May 1950. During the past 28 years Chapman has acquired a thorough knowledge of heavy stationary diesels.

C. H. Martin, master mechanic for Pan American Pipe Line Co., started with the company in February 1943 as station engineer, became division mechanic in October 1944, and master mechanic in April 1950. He attended Mechanical School in Kansas City, Mo., in 1929 and 1930, and has since been engaged in operation and maintenance of stationary gas and diesel engines. In 1931 he started with Tidal Oil Co. working on construction and operation of air plants. In 1934 he transferred to Tide Water Associated Seaboard, serving in various capacities in the production department for 4 years, and as assistant plant foreman in the recycling department for 5 years.

At that time, refined fuel oil cost $0.055 per gallon delivered at the stations. Then East Texas crude oil was worth $1.31 per barrel or $0.031 per gallon.

Now East Texas crude oil costs $2.65 or $0.062 per gallon (twice as much), while refined fuel oil is delivered to the stations at $0.0975 per gallon, which is relatively 11 per cent less. By converting these figures to cost of fuel per horsepower developed, it was found that with East Texas crude oil as fuel, the cost of developing 1 hp. amounted to $0.00361. When using refined fuel oil, this cost was $0.00342. The difference is $0.00019 per horsepower. When developing 19,200 hp.-hr. per day, the savings in fuel costs are found to be $3.65 per day for operating the total 800 hp. installed in the engines at the station.

The greater efficiency of refined fuel is indicated by the fact that 34 per cent less is required than crude oil. In the period since January 1946, only 0.024 gal. of refined fuel oil has been consumed per barrel of crude pumped. This is representative of

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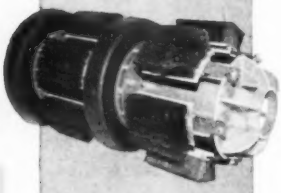
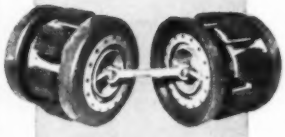
PIGS FOR CLEANING

← Small diameter lines type JR, 2" to 5".



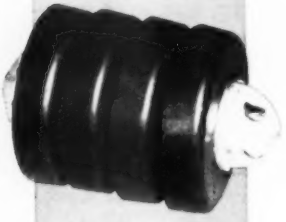
← Large Oil & Products Lines, 16" to 30", Type GP-4, Brushes expanded by arched springs.

← 6" to 14" diameter lines. Type WC-11, Brushes expanded by spring steel arms.



← Large Natural Gas Lines, 18" to 30" sizes. Type GP-3, Brushes expanded by arched springs.

PIGS FOR SEPARATION



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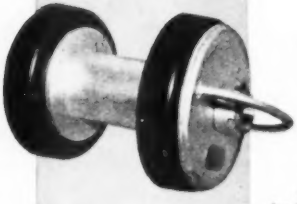

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current results. In the 1941-1945 period fuel consumption was 0.0365 gal. per barrel of crude oil pumped. At current prices, the difference between the cost of the two types of fuels means that it costs $0.0023 less to use refined fuel oil than it would to use crude oil.

TABLE 1—COMPARISON OF ENGINE OVERHAUL EXPENSES

	With crude oil as diesel fuel 1945	With refined as diesel fuel 1949-1950
Engine hours between overhauls	7,500	14,000
Horsepower hours between overhauls	3,000,000	5,600,000
Cost of overhaul labor per engine	$410.00	$586.00
Cost of parts installed during overhaul per engine	$346.00	$269.00
Total of labor and parts per overhaul	$756.00	$855.00
Cost of overhaul labor and parts per horsepower-hour	$0.00025	$0.00015
Saving, per cent		40

Loss of revenue during overhauling is estimated by considering the lost gross income as 10 cents per barrel. Throughput of the line is reduced 11,500 bbl. per day per engine shutdown. Therefore, during the 4-day overhaul period, gross revenue lost would amount of $460 per shutdown.

More significant than the savings in direct cost of fuel are those achieved in operation and maintenance.

Overhauling costs in effect have been cut in half by use of refined fuel oil. This is exemplified by data from periods representing the two types of fuel use. (See Tables 1 and 2.)

TABLE 2—REVENUE LOSS DURING OVERHAUL SHUTDOWNS

	With crude-oil fuel 1945	With refined diesel fuel 1949-1950
Loss per horsepower-hour	$0.00015	$0.60008
Reduction of revenue loss, per cent		46

Cylinder wear has been reduced with the use of refined fuel oil far beyond expectations (see Table 3). Instead of increasing as normally would be expected in the later life of the liners, this annual rate of wear has actually decreased.

TABLE 3—COMPARISON OF CYLINDER WEAR
(13 by 16-in. liners)

	With crude-oil fuel 1941-1945	With refined diesel fuel 1946-1950
Wear per year, in.	0.0015	0.00086
Saving, per cent		43

If crude oil had been continuously used for fuel it would have been assumed that cylinder wear would have been between 0.0003 and 0.0004 in. before now. This would have required replacement of six liners per engine with each liner costing $389. The 43 per cent reduction in cylinder wear may be regarded as $1,003.62 or $100.36 per year.

While 10 years is about the limit of service that may be expected in crude-oil service, it is believed that with the use of fuel oil during the entire life of the engine, it would be reasonable to expect that liners would last nearly twice as long as they would with crude oil as fuel.

Lubricating-oil consumption has decreased as indicated by Table 4. Engine oil is 40 S.A.E. detergent diesel lubricating oil.

TABLE 4—LUBRICATING OIL CONSUMED PER DAY PER ENGINE

	With crude-oil as fuel 1941-1945	With refined diesel fuel 1946-1950
Lube oil used, gal.	4.3	3.7
Per cent saved		10

Loss of revenue from crude oil taken from the line for fuel is a small item by itself, but it could be mentioned here since economies are by nature usually the sum of small savings. This saving would amount to approximately $10 per day per station using 100 bbl. of crude for fuel at full load.

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grades of crude shipped through the line but the East Texas grade has been regarded as the most suitable

CHARACTERISTICS OF EAST TEXAS CRUDE OIL

Specific gravity	0.833
A.P.I. gravity at 60° F	38.4
Saybolt Universal:	
At 40° F.	74
At 100° F.	43
Conradson carbon, per cent	1.97
Ash, per cent	0.001
Sediment and water, per cent	0.4
Sulfur, per cent	0.38
Ignition quality (cetane number)	65
Flash point (below), °F.	15
Pour test, °F.	20

Refined diesel fuel is standard grade designated as No. 2 diesel and has the following specifications:

A.P.I. gravity, °F.	38
End point, °F.	675
Flash, °F.	148

No residual fuel has been used for the company's diesel engines.

Storage facilities have been the same for both crude-oil and refined-fuel service, amounting to 400 bbl. per station. Regular deliveries of refined fuel oil are made from 100-bbl. tank trucks of two suppliers which are not affiliated with the company.

Centrifuging and straining of all crude oil for fuel was a regular practice. In using refined fuel oil, it only passes through a small strainer at the engine to safeguard against impurities.

The total advantage of using refined fuel oil in comparison with crude oil may be summarized as follows:

Savings in fuel, operation and maintenance for an 800-hp. station using fuel oil for 1 year in comparison with operation with crude oil as fuel (97 to 98 per cent load factor) are:

Fuel oil at $2.80 per day	$1,022.00
Overhaul (labor and parts)	622.08
Loss of revenue during shutdown	860.92
Cylinder wear	96.06
Lubricating oil	306.60
Loss of revenue for crude oil moved for fuel	365.00
Total annual	$3,272.66
Savings per year total for four stations	$13,090.64

The practice of using refined fuel oil, which brings improvements in all details of maintenance and operation, also contributes substantially to the value of a heavily loaded pipe-line system by facilitating high load-factor operations.

New Test Data on Magnetic Filters

(Continued from page 231)

There are two types of magnetic filters, the permanent magnetic type and the electromagnetic type. The permanent magnetic type of filter installed in a products stream has the disadvantage that a duplex type should be installed because it has to be cut off the line for cleaning or sludging. When a single unit is used it should have a cleaning mechanism, mechanically operated for a sludging effect which may have its complications. The permeability of the magnet and its magnetic attractive strength do not compare with the effectiveness of the electromagnet.

The electromagnetic type of filter can be so arranged in the piping system that when the current is taken off the unit, it will drop off most of the magnetic oxide and this oxide can be readily sludged to a pit. This operation can be accomplished in a minute or less time. Electromagnetic filter will not collect or catch the particles of nonmagnetic oxide or other foreign matter, and this must be taken care of by other methods. We have found that a good electromagnetic filter will take out of the stream all the magnetic oxide. Changes in stream velocity and turbulence apparently do not wash off the oxide because of the strength of the magnet.

Tests were made with an electromagnetic filter on partial flows, because we used a test model of small capacity on both the incoming stream side of the hay-type filters and on the discharge side of the hay-type filters, and found that it was equally efficient on either side. The electromagnetic filter on the discharge side of the hay-type filter was installed ahead of a felt or wire-cloth filter which is generally installed ahead of the meters. With the proper design of an electromagnetic filter it might be advantageous to install

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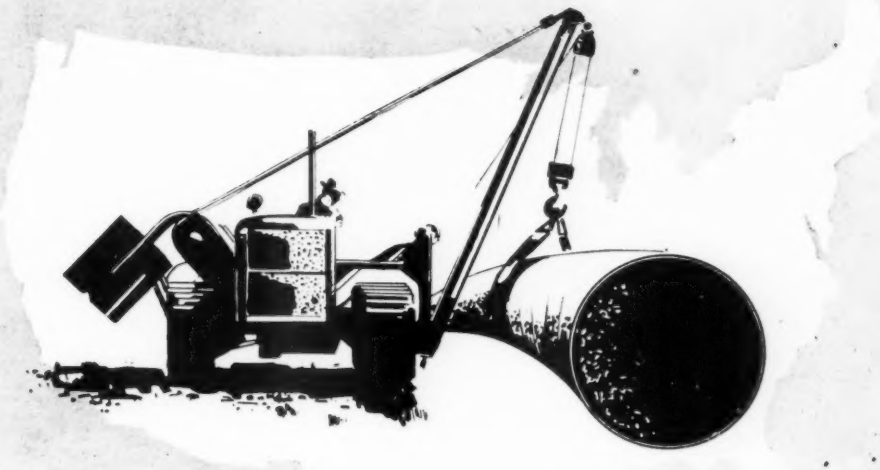

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same ahead of settling tanks, or hay tanks on installations, because the magnetic filter located at this point will take out all of the magnetic oxide from the stream before entering the hay tank or other types of filters, and increase the operating hours of the filtration medium used in filters of this type.

The thought of installing the magnetic filter on the discharge side of the hay tanks is that it would be close to the entrance of the meter and would eliminate the felt filters besides having the benefit of the hay tank filtering out some of the coarser magnetic particles.

From samples of oxides collected at takeoff points along the main lines and at the terminus of the pipeline system, all of the tests indicate that the oxide is 100 per cent magnetic Fe_3O_4 and no foreign matter and nonmagnetic oxide were encountered. These data were collected on chromate-inhibited lines.

On lines considered to be in excellent condition and operating at a high C factor, we have found that on a 12-in. line with a flow rate of approximately 30 000 bbl. of products per day, the electromagnetic filter will recover a spoonful of magnetic oxide per 24 hours. On lines that are considered in bad condition the amount of magnetic oxide caught by the electromagnetic filters is surprising. It is apparent that where the eletromagnetic filter takes out all the magnetic oxide and with no foreign matter or nonmagnetic oxide present, the meter bearings will give many more months of service before overhauling.

Electromagnetic filters should be so constructed as to be explosion-proof, with the proper pressure rating for the location, and the piping arranged to and from the filter so that the filter can be quickly sludged to the drain lines. On large-capacity filters, it is necessary to water cool the filter coils. The power input to electromagnetic filters is comparatively small being approximately 3 amp. for 115 volt d.c.

The high-pressure electromagnetic filter shown in the accompanying photograph was the type used in our tests with the exception that the filter body was made with standard flanged connections. The filter was installed with a bypass arrangement so that the stream could be bypassed around the filter when the current was taken off momentarily to sludge the oxide in the unit to the drain line.

It is conceivable that a hay or cartridge type of filter in conjunction with a magnetic filter could be unitized in such a manner that it would eliminate the use of felt or very fine mesh filters, that are usually installed close to the entrance of meters. The latter filters are a necessity in most systems, but their operation and maintenance present a troublesome and expensive operating problem.

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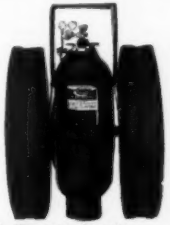

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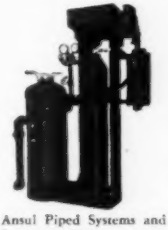

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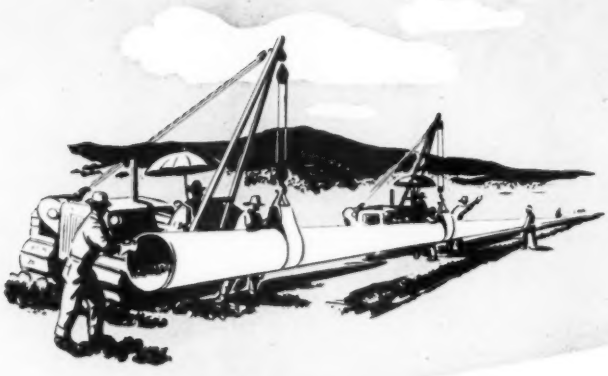

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Breaks in Pipe-Line River Crossings

by P. H. Timothy

The author believes that pipe lines can be designed to cross the Mississippi or any other stream with little, if any greater risk than when laid on dry land, provided the factors of safety employed in construction are commensurate with existing hazards

A SERIES of breaks in pipe-line crossings of the Mississippi River has been under investigation for the past several months. Although these studies are not complete, sufficient information is available to indicate the probable causes of failure as well as certain remedial measures which should be taken in future work.

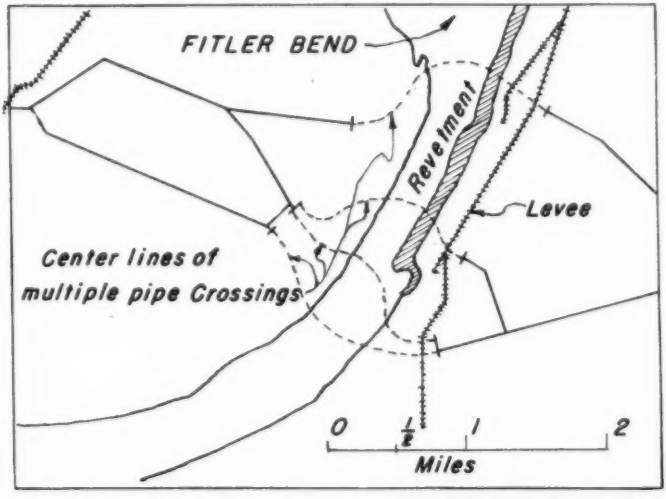
The crossings under investigation were constructed along a reverse bend in the river, known as Fitler Bend, about 30 miles above Vicksburg (see sketch). Along the west bank lies a wide and rapidly accreting bar which is completely submerged only at bank-full stages. The low-water shore line on the west bank has shifted eastward at a rate of about 150 ft. per year during the past 30 years. The east bank is under heavy attack and revetment in the vicinity of the bight was commenced in 1907. The resulting accelerated recession of the east bank below the revetment has attained rates of 300 to 400 ft. per year at certain locations. Extreme instability is characteristic of this entire section of river where banks are more or less continually accreting or receding and bottoms scouring or shoaling. Although the Fitler Bend reach is generally typical of this section of river, locations are available in the immediate vicinity which are relatively more stable and less hazardous for pipe line crossings.

The locations of the center lines of the multiple crossings lie within a reach of about 2 miles, as shown on the accompanying sketch. The size of pipe used in these crossings is mostly 10¾-in. by ¾-in. Some lines were bowed upstream while others were bowed downstream with curvature distributed more or less uniformly throughout their lengths.

All known locations of breaks lie along the east bank generally within 600 to 800 ft. of the water's edge. This places the breaks at the thalweg or in the deepest waters where maximum velocities occur. On reveted banks the breaks are approximately at the toe of the articulated concrete mats. The causes of breaks are believed due primarily to the lack of sufficient slack where needed and to inadequate weight of line or so-called "negative buoyancy." Caving banks and the laying of lines on the concrete mats have also been major contributing factors. The causes of the breaks at Fitler Bend are discussed briefly below:

1. **Scour.**—The extent and depth of scour are functions of bottom velocities. At Fitler Bend high velocities and deep scours are concentrated at the thalweg within a few hundred feet of the east bank. The bottom profile is almost flat over the bar or west side for about three-fourths of the width of the river. The bottom slopes vary gradually across the bar to the channel where it drops rapidly into a deep and narrow V-shaped gorge at the thalweg adjacent to the east bank. During floods a pipe line lying at or below the bottom and bowed either up or downstream could readily accommodate itself to the relatively small and uniform extent of scour which occurs over the bar section where practically laminated flow and slight changes in bottom velocities exist.

At the thalweg where violent velocity changes and extreme turbulence occur with rapidly rising gages, deep scours of the order of 40 to 50 ft. may be concentrated in a narrow cross-section of bottom 600 to 700 ft. in width. Although scour occurs across the bar, shoaling immediately follows on a falling gage. As the bar is accreting rapidly, the pipe line soon buries itself and generally remains imbedded except at the thalweg. Hence, with the increased gradients accompanying a rapidly rising gage, the pipe line is undercut in the



Pipe-line crossings of the Mississippi River at Fitler Bend, breaks in which prompted the investigation reported in this article.

THE AUTHOR

General Timothy is with Southern Natural Gas Co., Birmingham. He was General Omar Bradley's chief engineer when the latter commanded the American Armies in Europe. He graduated from West Point in 1918 and M.I.T. in 1921. He was assistant professor of engineering for several years at West Point. His acquaintance with the Mississippi River began in 1934 when he became the assistant division engineer of the Gulf of Mexico division with headquarters in New Orleans. After V-E Day he returned to this country as commandant of the engineering school at Fort Belvoir, Va. He held this command until his retirement in December 1946 for physical disability.

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channel and exposed to the extreme turbulence occurring at and near bottom. The line thus becames suspended for a distance of about 700 ft. across the thalweg. It is more or less firmly anchored at the end of this section and remains imbedded below the bottom across the bar.

Even if the line were free to move so that the necessary slack could be provided, suspension in part would still be possible due to insufficient flexibility to conform as laid to the side slopes of the scoured section. Investigations in potamology have demonstrated the effects of cyclonic disturbances at this location. The line is subjected to sinuous wave motion with increasing amplitude induced by resonance. These vibrations cause rapid crystallization of the metal and ultimate fracture. As previously stated, the lines laid at Fitler Bend are bowed either up or downstream with a gradual curvature distributed more or less uniformly throughout.

One reason for bowing of the line up or downstream is to provide slack so that the line can accommodate itself to scour. The futility of uniformly distributing slack over 6,000 ft. of line becomes obvious when it is realized that the scour is concentrated generally over only about 700 ft. of line. As the amount of slack available at any section of line is the difference between the segment and the chord, the slack available in such a short section is, therefore, practically nil. Hence, to be effective, sufficient slack should be made available where the damaging scour occurs or is likely to occur and not distributed uniformly throughout the length of the line, the great majority of which remains firmly imbedded.

2. **Hydrodynamic forces.** — Technical publications dealing with river-crossing problems indicate that little weight, if any, has been given to the science of potamology and that an analysis and evaluation of the hydrodynamic forces generated by moving waters have not been made. The cause of the many failures in river crossings is believed due to the lack of a proper consideration of these hydrodynamic forces. Furthermore, no theoretical approach has been observed for the determination of a proper weight of line or negative buoyancy. On the contrary, negative buoyancies have been arbitrarily adopted and values as low as 1.2 have been used. One company states that a negative buoyancy of 1.3 is used for all river lines.

Apparently the same negative buoyancy is used irrespective of the nature of the stream involved. Such an arbitrary approach may readily lead to disaster when applied to a stream like the Mississippi River. A negative buoyancy of 2 has been used on the lines laid at Fitler Bend. As the hydrodynamic forces at that location under conditions of maximum tur-

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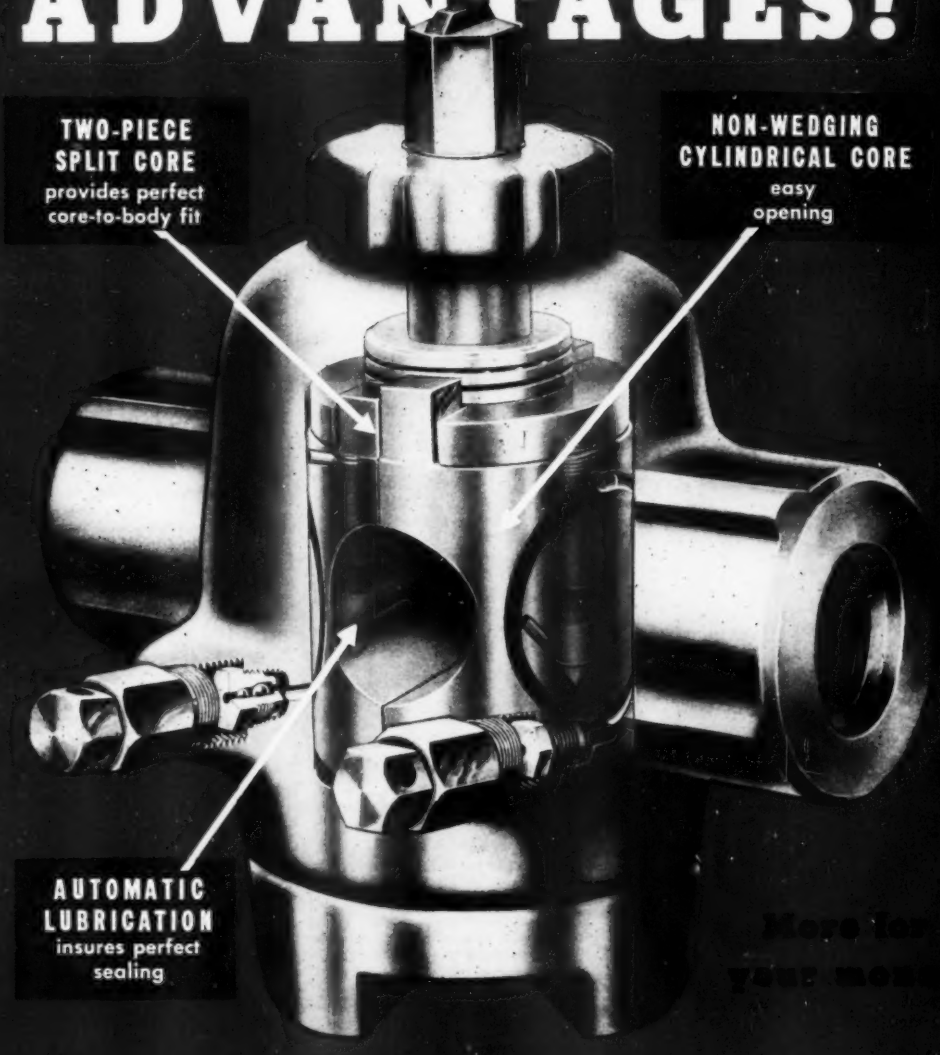

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bulence cause an uplift in excess of the hydrostatic buoyancy, a negative buoyancy of 2 is not sufficient to prevent these lines from being projected upward from the bottom in the vicinity of the thalweg. The lines will by no means rise to the surface. The hydrodynamic uplift varies as an exponential function of depth and, hence, vanishes at the surface.

A negative buoyancy in excess of 2 is required just to maintain vertical equilibrium at the bottom under conditions of maximum turbulence at Fitler Bend. This additional negative buoyancy required to overcome the hydrodynamic uplift is maximum at the thalweg and decreases towards the banks in accordance with variations in bottom velocities. Hence, lines should be properly weighted and the weight should vary in accordance with the resultant dynamic and static uplifts.

3. **Density.** — Hydrostatic pressures for pipe-line crossings of the Mississippi River have in general been based on a fresh-water density of 62.4 lb. per cu. ft. During critical periods of high turbulence, the density of the river water when surcharged with colloidal materials and bed load sands is well in excess of 62.4. This increased density further decreases the effective negative buoyancy of lines laid in the Mississippi River and, accordingly, is another factor contributing to previous failures.

4. **Caving banks.**—The accretion of the bar on the west side of the river tends to restrict the channel, causing increased velocities and erosion of the bank opposite the bar. The receding bank on the east side is in effect being pushed back by the accreting bar on the west side. Below the revetment on the east bank, the rate of recession is 300 to 400 ft. per year at certain locations. The sloughing off of the bank occurs during sudden rises of the river, generally preceding floods. These receding banks constitute a major hazard to pipe lines unless proper precautions are taken. Below the low-water plane, the banks in general consist of fine sand having a small angle of repose. Above the low-water plane, the banks are principally loam with a relatively large angle of repose, especially with a high moisture content. When sufficiently moist the upper portion sloughs off almost vertically.

The banks slough off in conically shaped sections of several hundred feet in diameter. The saturated sand below the low-water plane becames quick and flows outward from under the superimposed mass when triggered by a sudden rise. Initially the upper 40 to 50 ft. above the low-water plane is supported by arch and cantilever action until it collapses. Below the low-water plane the material is constantly immersed and flows. Above the low-water plane a 40 to 50-ft. section of earth may have a free fall, principally in air, and such action

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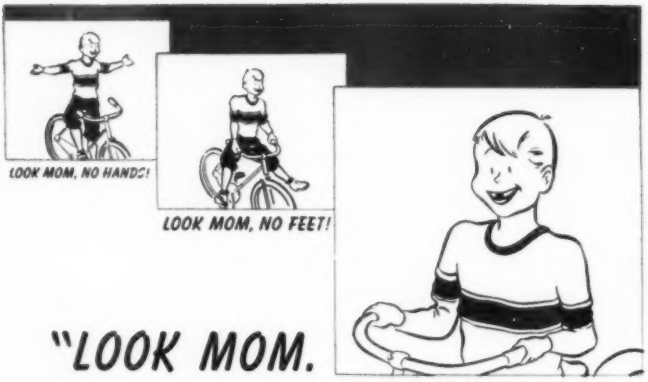

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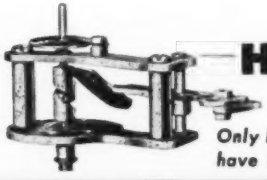

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will bend and possibly fracture any pipe lines laid in the bank. Accreting banks should be cut down approximately to the low-water plane with a trapezoidal cross-section and the cut should extend back at least twice the annual rate of recession. Yearly maintenance at the banks is necessary.

5. **Concrete revetment.**—The Fitler Bend revetment consists of articulated concrete mats laid on the east bank and extending to the thalweg. The purpose of the revetment is to prevent recession and thereby stabilize the bank. Accretion of the bar opposite the revetted bank, however, continues. This encroachment by the bar on the channel causes a restriction which induces venturi action resulting in accelerated bottom velocities, increased scours, and greater depths. In other words, the bar continues to push against the bank and since the bank cannot recede the bottom gives instead. This action accompanied by increasing depths and velocities normally continues until the bar stops accreting or until the revetment fails, resulting in a possible setback of the levees. The mats conform to the uneven banks and are subjected to maximum turbulence at the toe. As the mat offers greater resistance to scour than the river bottoms, deep holes may be cut at the toe of the mat causing the ends to drop and disintegrate.

A pipe line laid across a concrete mat is suspended between points of contact and at the toe and thus exposed to everything the river can throw at it. The suspended pipe is not only subjected to the maximum turbulence of the river but its conformation further increases this turbulence. If pipes must be laid across concrete mats, streamlining might be in order to reduce turbulence. The swaying and vertical motions of the pipe cause intense impacts and abrasions at the points of contact with the mat.

Furthermore, the mats are known to flutter at the toe with extreme turbulence. Hence, we not only have the pipes pounding the mats but we have the mats pounding the pipes. In view of the foregoing, the laying of pipes across concrete mats is not recommended.

It is firmly believed that a pipeline crossing of a meandering stream in an alluvial valley has little chance of success if such a crossing consists of an inflexible design based upon predetermined depths or other rigid assumptions. In view of the constantly varying river conditions and especially the uncertainty of forecasting future changes, a successful crossing should be flexible and able to give with the punch or to adapt itself to all probable changes. Accordingly, the design of a crossing should not only be based on existing conditions but also upon changes which can be anticipated within life of lines as well.

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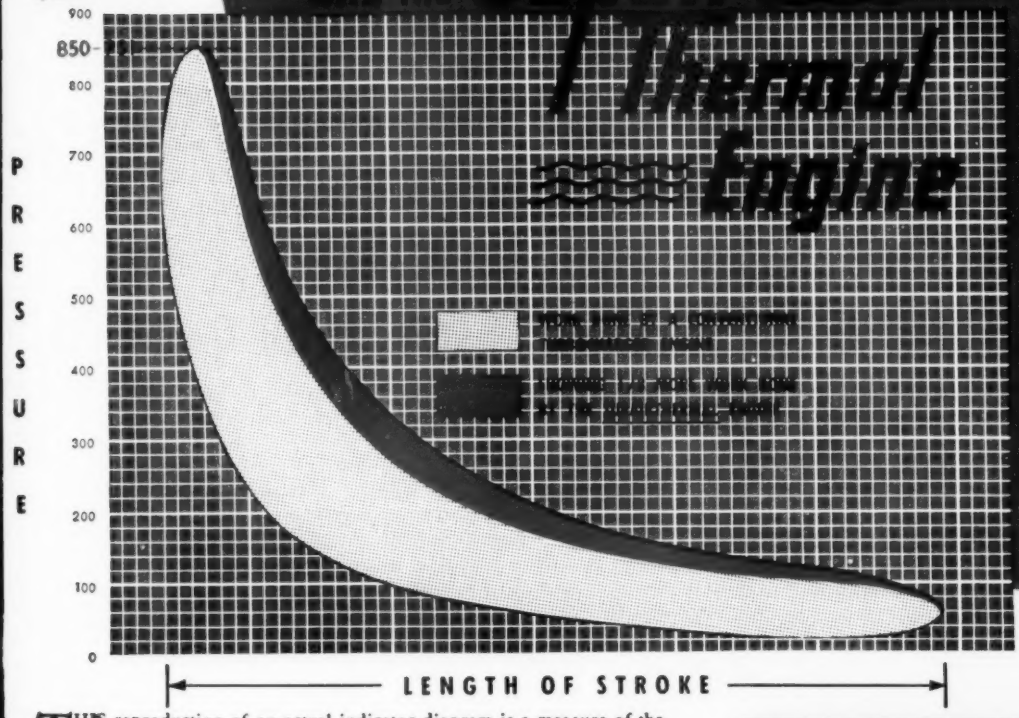

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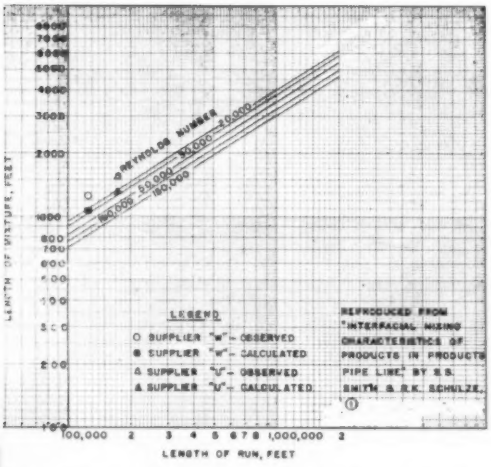
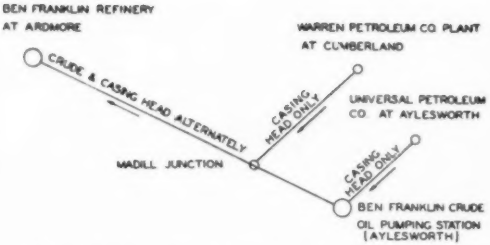


Fig. 1—Lengths of mixture vs. run, related to Reynolds numbers of 50/50 product blends.


BEN FRANKLIN REFINERY AT ARDMORE
WARREN PETROLEUM CO. PLANT AT CUMBERLAND
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CASING HEAD ONLY
UNIVERSAL PETROLEUM CO. AT AYLESWORTH
MADILL JUNCTION
CASING HEAD ONLY
BEN FRANKLIN CRUDE OIL PUMPING STATION (AYLESWORTH)

Fig. 2—Bell Oil & Gas Co.'s casing head-crude oil system.

The practice of alternating currents of crude oil and casing head has been used by the author's system with success over a period of years. There has never been any trouble in receiving clean 18-color casing head fit for blending with gasoline, nor has there been any serious loss by contamination in the mixtures.

Batching Casing Head Alternately With Crude Oil

by I. A. Anson

FOR the past few years Ben Franklin Refining Co., of Ardmore, Okla., 100 per cent subsidiary of Bell Oil & Gas Co., Tulsa, has been pumping batches of natural gasoline alternately with batches of crude oil in a 4-in. pipe line. The line is about 32.9 miles long, from Aylesworth, Okla., to Ardmore, passing through Madill, about 9.1 miles distant from Aylesworth, 23.8 miles from Ardmore.

Bell's successful experience in alternate pumpings of crude oil and casing head may prove useful to refiners. Some of these now pump blends of crude and casing head, where the blend contains more casing head than is needed to reduce viscosity and thereby improve the pumping by obtaining a more fluid mixture. The excess casing head in such a blend causes a considerable refining loss, especially in such plants as do not have crude-stabilization equipment. Even in plants that are equipped with stabilizers and absorbers on the crude skimming unit, the refining-process loss is needlessly large when charging a crude mixture that contains a large component of casing-head gasoline. Moreover, the skimming equipment is needlessly oversize as it must make room to distill and then to condense a constituent such as casing head which has already been fully refined and is fit to be blended directly with gasoline without being reprocessed.

Refiners and pipe liners may also profit beyond Bell's experience if further studies prove the possibility of using one line for both "clean" and "dirty" products. It is reported that Phillips Petroleum Co. will batch No. 4 burner oil along with clean products in its pipe line. It may develop that under certain conditions one of the dirtiest of all products, namely No. 6 fuel oil, might also be batched. The determining factors would be the amount of discoloration of clean products that could be tolerated and the amount of slop that is economically tolerable when slop is necessarily made at the front and rear end of each batch. The amounts of slop and of discoloration will be in ratio to the "washability" of the inside surface of the pipe. Bell finds that 36°-gravity crude oil is easily washed from the walls of a 4-in. line by 20 bbl. of casing head or 1,269 ft. of wash. Whatever is not removed, will remain on the side walls by tight adhesion and will not noticeably affect the main volume of the casing head that follows the "wash."

Loading Rack at Madill

At Madill, Warren Petroleum Corp. has a tank-car loading rack at the terminus of its natural-gasoline pipe line from its casing-head plant at Cumberland, Okla. Warren's natural-gasoline line has a junction at Madill with Bell's crude-oil line. Once a week Warren pumps 2,000 bbl. of casing-head gasoline directly into Bell's line which is full of crude oil.

At Aylesworth, Universal Petroleum Co. has a casing-head plant that also supplies casing head to Ardmore via the crude-oil pipe line. Appointments are made with both casing-head plants to pump on the same day; the first pumping to be from Universal's plant at Aylesworth and immediately thereafter to be followed by the second pumping from Warren's plant at Madill.

A telephone system is being installed and will soon be in operation, connecting the casing-head plants at Madill and Aylesworth and the crude-oil pipe-line station at Aylesworth. But up to this time all operations have been managed without a telephone and only by appointments which are about as follows. It is arranged that at some given hour and minute, the pumping of casing head from the Aylesworth plant shall start and shall continue at a specified rate of 100 bbl. per hour with a definitely known quitting time. This permits an appointment for the pumper at Warren's plant to start at the very moment that Universal's pumper at Aylesworth quits. The Warren pump operates at an agreed rate of 100 bbl. per hour.

Since it is important that there be no interval between the moment when the Warren casing-head pump stops and the Aylesworth crude pump commences, it is necessary for the Aylesworth crude pump to be in operation shortly before the Warren's casing-head pump stops.

The Aylesworth crude pump commences with its bypass wide open, delivering nothing into the line but merely circulating through itself

from discharge back to suction. The pumper keeps his eyes on the clock watching for the expected quitting time by Warren's casing-head pump, which is the starting time for Bell's crude pump. He keeps his eyes alternately on the clock and on the pressure gage which indicates 650 psi. on the crude line. He keeps one hand on the gate wheel ready for instantaneous movement of the crude oil into the pipe line.

The pumper is alert for the expected pressure drop from 650 to 625 psi., or thereabouts, caused by Warren's changing the three-way stopcock at the Madill junction, cutting off their gasoline and opening the passage for Aylesworth crude. He thereupon spins open the valve to the crude line and closes the bypass valve to the suction and proceeds to put crude into the line at the rate of 150 bbl. per hour. Thus, he pushes all the casing head received from Universal and Warren into the casing-head tanks at Ardmore, after displacing the crude oil which is ahead of the casing head in the pipe line.

Low Contamination

The result is that Bell obtains nearly all of 3,000 bbl. of 18-color casing-head gasoline, 2,000 from Warren and 1,000 from Universal, and contaminates with crude oil only 20 bbl. of casing head at the front end and the same quantity at the rear end of the casing-head batch, since the line fill between Aylesworth and Madill is about 755 bbl. in 9.1 miles at 83 bbl. per mile. The delivery by Universal is never less than 1,000 bbl., to make sure that there be no batch of crude between the two casing-head batches supplied by Warren and Universal.

The line is cleaned of crude oil by the first 20 bbl. of casing-head gasoline at the front end of the batch. Twenty barrels of casing-head gasoline, at the rear end of the batch, is contaminated by the crude oil behind the casing-head gasoline. Out of the total batch of 3,000 bbl. pumped by Warren and Universal, Bell receives 2,960 bbl. of clean casing-head gasoline suitable for blending with its bronze regular gasoline, or red premium gasoline, and receives the remaining 40 bbl. of casing-head gasoline as an admixture with crude oil.

The main caution is that the pumping, either by Warren's or Universal's casing-head pumps or by Bell's crude-oil pump that follows them, always be steady and uniform and without surges. The steadiness of the pump-

THE AUTHOR

I. A. Anson, vice president, Bell Oil & Gas Co., and president, Ben Franklin Refining Co., studied at University of Tulsa school of engineering after receiving degrees of B.S. from Columbia College, A.M. (in philosophy) from Columbia University, and doctor of jurisprudence from John Hopkins University in political science. After discharge as first lieutenant, 17th Infantry, in 1919, he was employed by the Midco organization in refining and sales engineering for 2 years. From 1921 to 1934 he participated in the management of Altitude Petroleum Co. which was merged at the end of this period with Bell Oil & Gas Co.

Picture Sequence of the Sampling Operation

Photograph at left shows a sample being taken while crude is known to be arriving at the transfer point of the refinery at Ardmore, where, by means of valves, the line contents are directed or transferred either into crude-oil tanks or casing-head tanks. The sampler knows when the casing head is expected to arrive and he takes samples every few minutes to determine whether the material arriving at the transfer point is all crude, or all casing head, or a mixture of the two, which must go into the crude tanks.

Photograph at right shows a sample taken of all casing head, at which time the line contents are directed into the casing-head tanks. In between photographs 1 and 2, imaginary photographs taken at intervals of 2 to 3 minutes would show the sample to be successively lighter and lighter in color until the transfer man is satisfied that the material arriving at the transfer point is clean color and fit to go into the casing-head tanks.

This photograph shows the three samples for comparison. Sample to the right can be described as 100 per cent casing head; sample to the left as 100 per cent crude; sample in the middle, though it shows up quite dark in the photo, was over 95 per cent casing head. The contamination of casing head, by even so small amount as 1 per cent of crude oil, would darken the color so much as to render it unfit for blending with gasoline.

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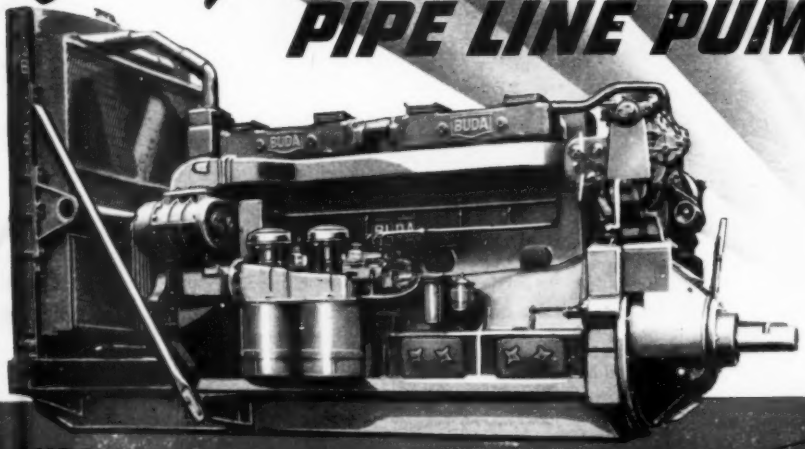

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TABLE 1—DATA ON NATURAL GASOLINE-CRUDE OIL BATCHING

A. Crude oil—Aylesworth area, 36° to 37° A.P.I.
B. Natural gasoline—25 color at casing-head plant, and + 18 Saybolt color at destination, 83.5 A.P.I., 18 R.v.p.
C. Pumping data for 4-in. line.

Supplier	Pumping rate, bbl. per hour	Reynolds number	Observed length of mixture, ft.	Calculated length of mixture (1) ft., est.	Length of run, ft.
"W"	100	24,500	1,269	1,050	126,900
"U"	100	24,500	1,587	1,300	173,500

ing causes the casing head to move almost as if it were a solid, so that none of its intermingles with the crude oil, either ahead of the casing head or behind it, except about 20 bbl. at each end. Furthermore, the crude-oil pump must start instantly after the casing-head pump is stopped.

When this plan was proposed, it was looked upon as being impracticable, principally because of two drawbacks. The first was the expectation of voluminous commingling at both ends, which commingling is now avoided by the steadiness of the pumping. The second drawback was the fear that the side walls of the pipe line would contain crude oil to such an extent as to contaminate and discolor the entire 3,000-bbl. batch of casing head.

In debating the second objection, a bonus was offered to the objectors if they would completely clean a crude-oil line by passing casing-head gasoline through it. The objectors declined to undertake such a task. They knew how impossible this would be, because in the refinery it is difficult to clean any line without using special chemical solvents. Sometimes the line has to be turbined. When the objectors realized that they could not clean out or remove the crude oil from the side walls, they realized also that whatever crude oil remained on the side walls by tight adhesion would obviously not enter the casing head.

If casing-head gasoline could not clean the line, then by the same token the crude-oil film on the pipe line wall could not dirty the casing head. The objectors were persuaded that it was a good plan to pump casing head in batches through a crude-oil line alternately, so that on 6 days crude oil would be pumped, and on one day casing head would be batched in the line full of crude oil. Thereupon, the necessary contracts and junction installations were made. The venture proved successful and is still in practice after satisfactory experience for several years.

Fig. 1 indicates only a slight deviation in respect to contamination, as between interfacial mixing characteristics observed by S. S. Smith and R. K. Schulze and reported by them in a paper presented at the November 10, 1947, meeting of the American Petroleum Institute.

In Table 1 Warren's and Universal's pumpings are shown according to observations made when the pumpings took place at separate times and not in sequent combinations, as generally practiced at present. The Warren pumping for a distance of 126,900 ft., length of run, would have a calculated 1,050-ft. length of mixture, and was observed to have about 1,239 ft. length of mixture. The observations on Universal's pumping show equally small deviations from Smith's and Schulze's figures as indicated in Table 1.

Since the pumping is at a known velocity of either 100 or 150 bbl. per hour, it follows that the flow is at the rate of 1.67 bbl. per minute when the casing-head pumps are at work and at 2.5 bbl. per minute when the crude-oil pump is in action. The transfer man at destination knows accurately when to expect nothing but crude oil or nothing but casing head and when to expect a mixture of the two in various proportions. He knows that the 4-in. line holds approximately 83 bbl. per mile, and the rate of flow. He takes samples at the front and rear end of each batch and makes his transfers accordingly.

Reference

1. "Interfacial Mixing Characteristics of Products in Products Pipe Line," by S. S. Smith and R. K. Schulze, 1947 A.P.I. meeting.

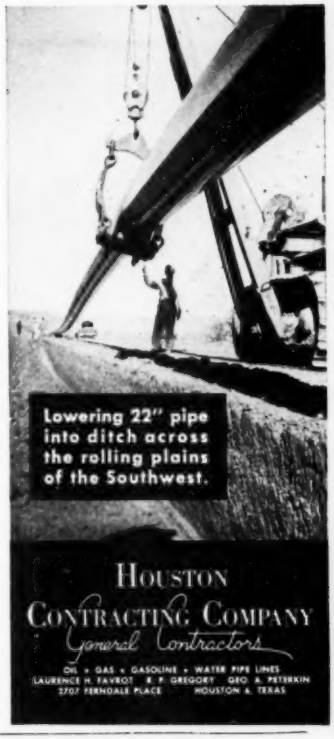
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Chart 1—Determination of Working Stress in Pipe Line (Based on Barlow's Formula: P = 2ST/D)

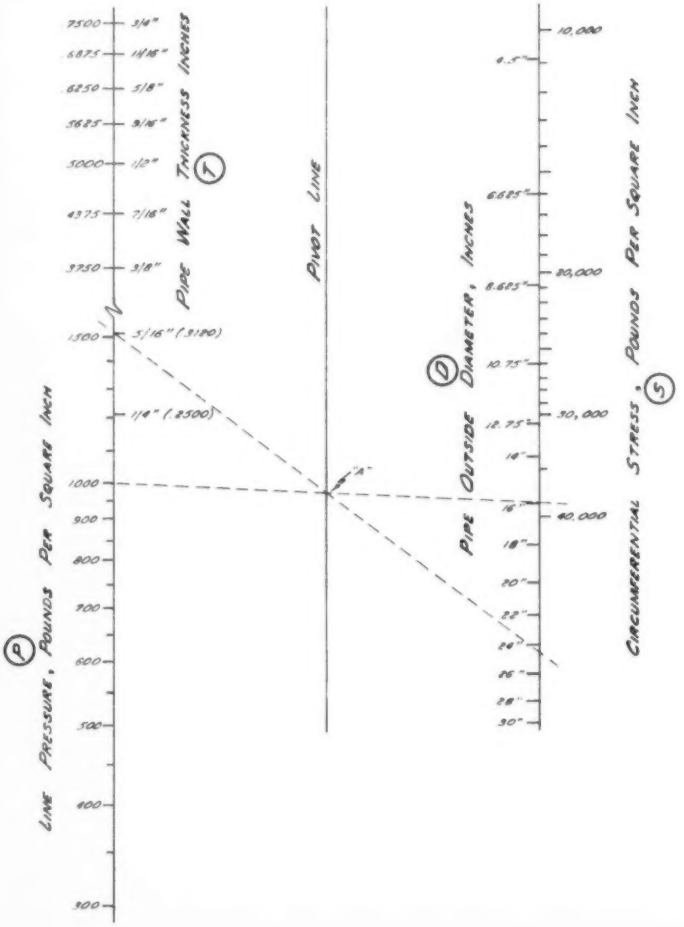
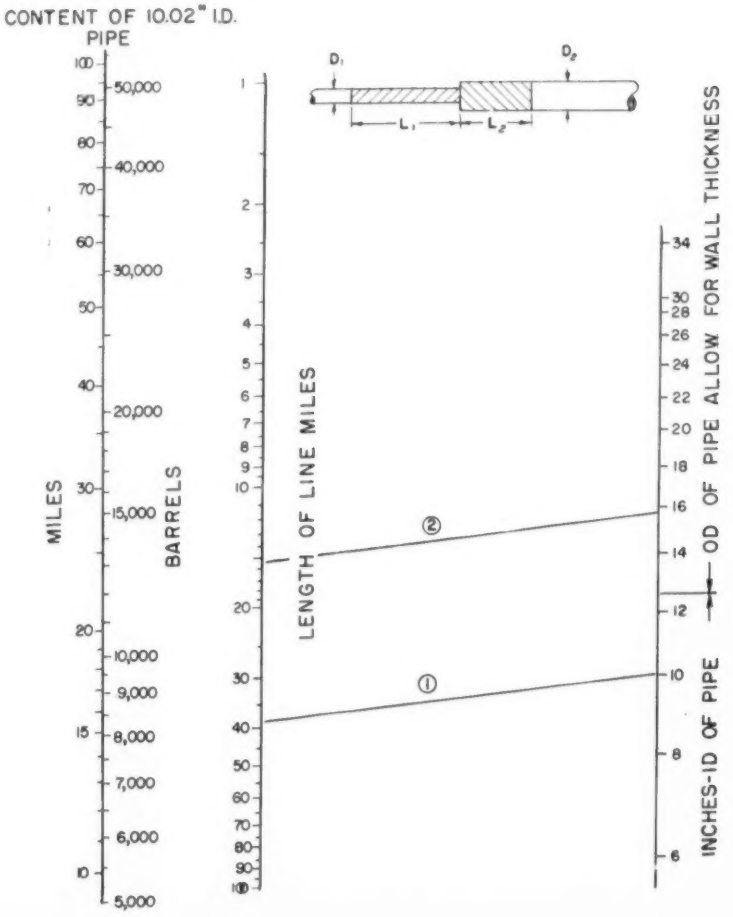


Chart 2—Estimation of Length of Pipe Line Occupied by Given Volume of Crude Oil or Products



Three Helpful Charts for Pipe Liners

by Frank G. Hangs*

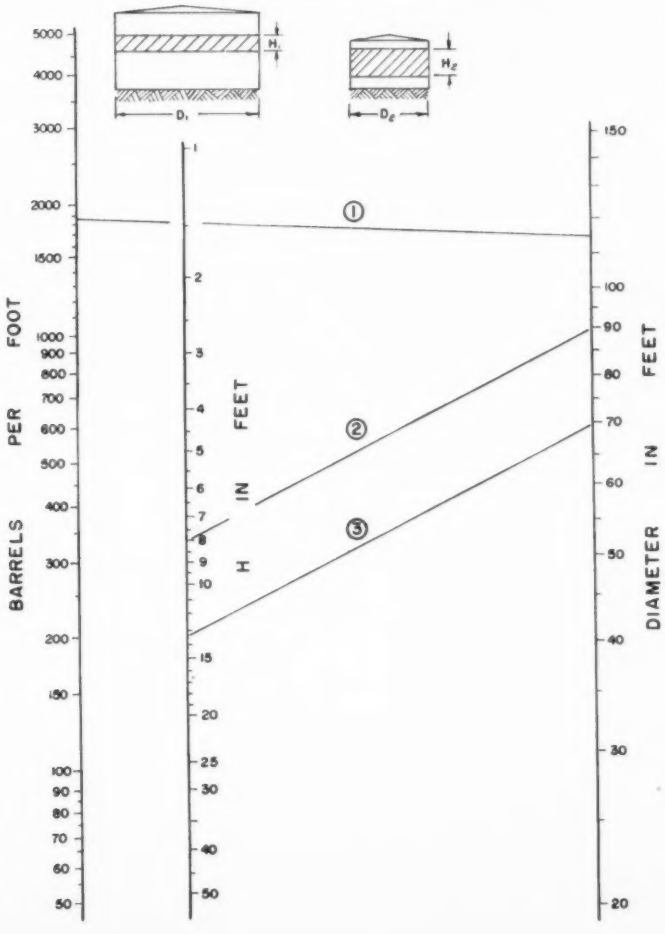
IN pipe-line operations there are many occasions where it is helpful or even essential to have a quick estimate of the values of specific variables at a given time. For example, it is advantageous to know how the stress in a pipe line will vary with the working presure. It is often necessary to determine quickly, with reasonable accuracy, how many barrels are contained in a certain size pipe of a given length or to estimate the length of a column containing a given number of barrels in a specific pipe size.

Numerous problems arise in transferring oil between tanks. It is convenient to know that 10 ft. of oil from one tank will make only 4 ft. in another tank of larger diameter. When oil from a larger tank is transferred to a smaller-diameter one, the question of room becomes more critical.

The accompanying three charts are offered for what value they may have to busy pipe liners in assisting in their daily operations.

*Mechanical engineer, Houston

Chart 3.—Estimation of Height Occupied by Given Volume of Liquid in Tanks of Different Diameters.



Determine Working Stress in Pipe Lines by Barlow's Formula

Chart 1.—This chart can be used in several ways:

1. Given line pressure and allowable stress; connect values on pressure and stress scales to determine point "A" on the pivot line. Pivot about point "A" and read combination of pipe diameter and wall thickness on the appropriate scales.

2. Given specific pipe; connect diameter and thickness to determine point "A." Pivot about point "A" and read combinations of line pressures and corresponding stresses.

Estimating Length of Given Quantities of Oil in Pipe Lines

Chart 2.—Given: 38 miles of 10-in. i.d. pipe, what length will this quantity be in 16-in. o.d. pipe? Draw line from 16 in. (allow for wall thickness) parallel to line (1). Read 15.5 miles. Length of this same quantity of oil can be found in other pipe sizes by drawing lines parallel to (1) and the desired diameter.

Estimate the volume of oil in a pipe of given length as 15.5 miles of 16 in. Draw line parallel to (2) through the 10-in. diameter and read the corresponding length 38 miles. Refer to the scale on the left for 10.02-in. pipe—opposite the miles read the desired quantity.

Find the length of a given quantity in any size pipe. Read the length of 10-in. pipe which corresponds to the given quantity (barrels) on scale at left. Connect the 10-in. diameter and this length. Draw parallel line through the required diameter read desired length.

Estimate Height of Given Volume of Oil in Tanks of Given Diameters

Chart 3.—If tank diameters are known, connect "D_1" and "H_1." Draw parallel line through "D_2" and read "H_2." This is for the same quantity of oil in each tank.

If tank diameters are not known they can be found readily as follows: A standard 55,000-bbl. tank, 115 ft. in diameter holds approximately 1,850 bbl. per foot. This line (1) is drawn on the chart. One can determine the barrels per foot in a tank he is interested in. Draw a line through this quantity parallel to (1) and read desired diameter. It is suggested that the user enter the tank numbers near the proper diameter on the chart so as to make the chart more useful.

Pipe prior to processing for grease removal.

Here's how

Interstate Cleans Old Grease-Coated Pipe for Further Service

Interstate Oil Pipe Line Co. is presently removing grease coating and corrosion products from old grease coated pipe by dipping it into a hot aqueous solution of chemicals and solvents. Trial cleaning and coating tests employing a conventional-type mechanical pipe-cleaning machine showed that grease absorbed in the pores of the pipe as well as corrosion products in the corrosion pits had to be removed if a good bond between coal-tar enamel and pipe was to be obtained. Plant layout and production steps were worked out so that a constant time interval for exposing pipe to chemical was automatically controlled. This process resulted in the successful processing of 44 miles of 12-in. pipe at a rate of one 40-ft. joint every 5 minutes.

by James M. Smith and Robert L. Bullock

DURING the present national emergency, the expansion of pipe-line systems has depended primarily on the availability of steel pipe. This scarcity of new pipe has put a demand on old pipe that has seen years of underground service. Most of these old lines were screw coupled and laid bare.

An expansion of Interstate's Louisiana system was made possible by the availability of pipe retired from an old 12-in. system. This system was screw coupled and had been reconditioned with grease-type coating being applied at the time of reconditioning.

The pipe was removed from the ground, carried to a central yard, and processed. The processing included removing collars, straightening, cleaning with conventional cleaning machine, grading, double jointing, and beveling. Since specifications for constructing the new system called for the application of a coal-tar-enamel coating it was anticipated that another step, that of removing all grease from the pores of the pipe as well as corrosion products from the pits, would have to be worked out. Field tests bore this out, resulting in the setting up of a degreasing section at the processing yard.

Removal of grease and corrosion products by dipping, employing a hot chemical solution, has been successfully used throughout various industries. It is believed, however, that its application to pipe lines at a processing yard is very limited. In other words, the job at hand had to start from scratch and go through a pilot-plant stage in order to perfect a workable solution that was practical.

Some of the many problems that had to be determined by trial-and-error methods were (1) size of dipping vat, (2) concentration of chemicals and temperature of solution, and (3) production schedule. After many joints of pipe were dipped and redipped, a plant was constructed that came very close to solving all the problems.

Construction of Vat

The dipping vat was constructed by welding old tank-steel plate to the following dimensions: Width, 6 ft. 6

Three steps in cleaning grease coated pipe. Left to right: lowering into vat; removing from cleaning bath; placing cleaned pipe on skids.

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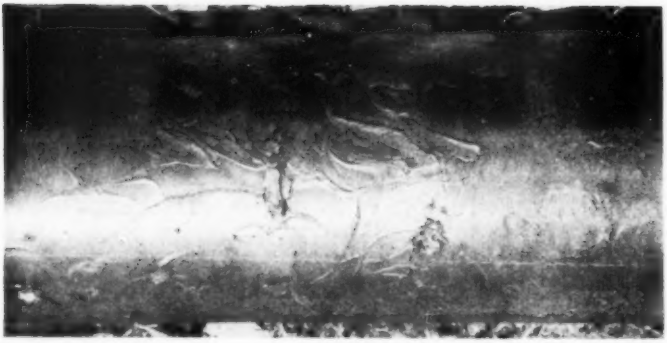

Coal-tar coating, applied to this section of degreased pipe, has been beaten off to show bonding characteristics of coating.

in., length, 50 ft., depth, 4 ft. These dimensions were sufficient to accommodate a 4-in. steam coil on the bottom and a U-shaped rack made of 4-in. pipe at each end to hold five joints of 12¾-in. pipe lying side by side. The racks, resting on the steam coil, served two purposes in that they took most of the shock of lowering and raising the pipe from the tank sides and also made it possible to set up a production schedule.

By sloping the bottom of the racks away from the entering side of the vats to the removal side, pipe placed in the vat on the entering side rolled to the removal side by gravity. One length of the steam coil was perforated with holes so directed that the escaping steam would tend to boil or give a rolling motion to the liquid. This motion of the liquid was very helpful in removing the grease. The vat was placed in the ground as far as practical. The ground insulated the sides of the vat and then the lowering of the vat made it more accessible.

Chemicals and Temperature of Solution

Repeated tests showed that best results were obtained when the concentration of chemicals was in the ratio of 1 to 1.5 lb. per gallon of water. The chemical employed was one of the patented high-alkaline materials with a pH of 12 to 13, especially designed for cleaning purposes. The tests also showed that temperature of the solution should be from 210° to 220° F. This required approximately 100-psi. steam in the boiler at all times.

It was also found that grease would shed from the pipe if 2 to 5 per cent of solvent was added to the solution. Some of the added solvent stayed on top the solution and helped prevent the removed grease from being picked up by the pipe, especially when the pipe was being removed from the vat. The solvent also formed a waterlock around particles of removed grease, reducing its clinging characteristics. It was also found that the strength of the solution decreased with the amount of pipe treated and grease removed but that it would not lose strength overnight. In one case the solution was left unused for 2 weeks with no reduction in strength of chemicals.

Production Schedule

Size and shape of the dipping vat and the effectiveness of the cleaning solution determined the production schedule. It was found that most of the pipe had to be treated for at least 5 minutes. This fitted in with the size of the vat as it required 5 minutes to place five joints of pipe into the vat. Thus, once the vat was filled the production schedule called for the removal of the first joint placed into the vat followed by the placing of another joint into the vat on the entering side. The slope of the rack kept the pipe moving in order from the entering side to the removing side. Thus, each joint experienced the same immersion time. This proved very helpful and made the element of time an automatic procedure.

Results Obtained

The effectiveness of this method of removing grease and corrosion products was reflected in the type bond obtained between the cleaned pipe and coal-tar-enamel coating. Results showed that if the grease was removed the coating bond depended primarily on the technique of applying the protective coating. For example, a good heavy coat of primer was required, especially on the pitted pipe; and also that primer thinner added to the primer reduced the bond. Temperature of the enamel was also a very important point in obtaining a bond. If the enamel was not up to proper temperature when applied, a very poor bond was obtained. It can be said that considering the condition of the pipe before cleaning that an excellent bond was obtained on the pipe thus cleaned.

This method of removing grease and corrosion products from old pipe is not presented as a conclusive solution but rather as a method that does a good job and still is flexible enough to stand improving. Future plans call for improving the method and investigating other methods which may prove more effective and economical.

THE AUTHORS

J. M. SMITH

R. L. BULLOCK

James M. Smith is corrosion engineer for Interstate Oil Pipe Line Co. He is a 1943 graduate of Louisiana Polytechnical Institute from which institution he received a B.S. degree in electrical engineering. He entered the armed services after graduation with the rank of first lieutenant in the Marine Air Corps and remained in the service through 1946. While in training he completed special radio and radar courses at M.I.T. and Harvard. He joined Interstate Oil Pipe Line Co. in 1947 and was assigned to corrosion work in 1949.

Robert L. Bullock is head of the corrosion section of Interstate Oil Pipe Line Co.'s engineering department. He is a 1931 graduate of Texas A. & M. from which institution he also received his M.S. degree in electrical engineering. Since graduation he has been in the employment of Standard of New Jersey companies, both domestic and foreign, for the past 16 years. These included Humble Oil & Refining Co., Australasian Co., Pty., Ltd., and Carter Oil Co. He joined Interstate in 1944 and was assigned to corrosion work in 1945.

Pipe-Line Techniques Advance

(Continued from page 176)

lated oil fields where gas is now being wasted, or for lines across the desert where the use of a few oil-fired turbines with large horsepower output each would minimize the operating and maintenance problems of such isolated locations.

Use of gas-type turbines on pipe lines might allow the development of a master pump station where the turbines would be directly connected to generators for supplying electrical power for all purposes. This power could be used for driving the oil pumps in the master station and some of the electric energy could be transported each way from the main station to operate what might be

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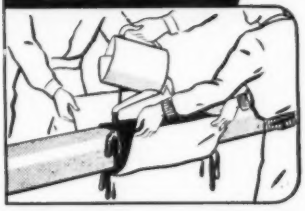
Slip on - Pour full - Lower in

OLD METHOD



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PRODUCTION ECONOMICS...

by Pacific PUMPS INC.

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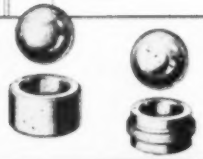
Q	Why is oil at the bottom of the well like money in a safe deposit box?	A	Because it is a LIQUID ASSET IN DEAD STORAGE WITHOUT EARNING POWER.
Q	Can this condition be changed?	A	Yes — both can be activated and given earning power.
Q	How can they be activated?	A	Draw some of the money from the safe deposit box — purchase and install a Pacific Oil Well Plunger Pump in the well — pump the oil to the surface. MONEY IN CIRCULATION — OIL IN CIRCULATION — BOTH WITH POWER TO EARN.
Q	Why purchase and install Pacific Oil Well Plunger Pumps?	A	Because only Pacific gives you the EXCLUSIVE MOLOY® LINERS with the strength, toughness, hardness, combined with greater resistance to temperature, corrosion and abrasion essential for long, economical life.



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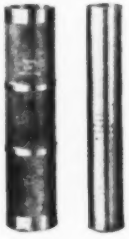

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called auxiliary booster pumps to increase the over-all flow through the line.

These auxiliary units under remote control would prove effective in maintaining the maximum volume when crudes of different pumping characteri.tics are being batched through the line. They would also level out the effects of temperature variations on long lines built above .he ground especially in hot coun-tries. All of these new things require study, investigation and tryout under actual operating conditions and offer some interesting possibilities.

The progress made by pipe lines in recent years is a good example of what can be accomplished by combining American ingenuity and know how with sound engineering principles in improving the design and operation of pipe lines and pump stations. This has brought the pipe-line companies to the enviable position of being able to provide safe and satisfactory tran.portation for crude and petroleum products at reasonable rates while at the same time providing a fair return on the investments involved.

This continued interest and enthusiasm of the engineers and research people with the support of the oper-.tors and owners, all working together to improve the service, assures the industry and the public of efficient and economical transporta-ion of oil wherever it is needed throughout the world.

Coates Offers New Packaged Service

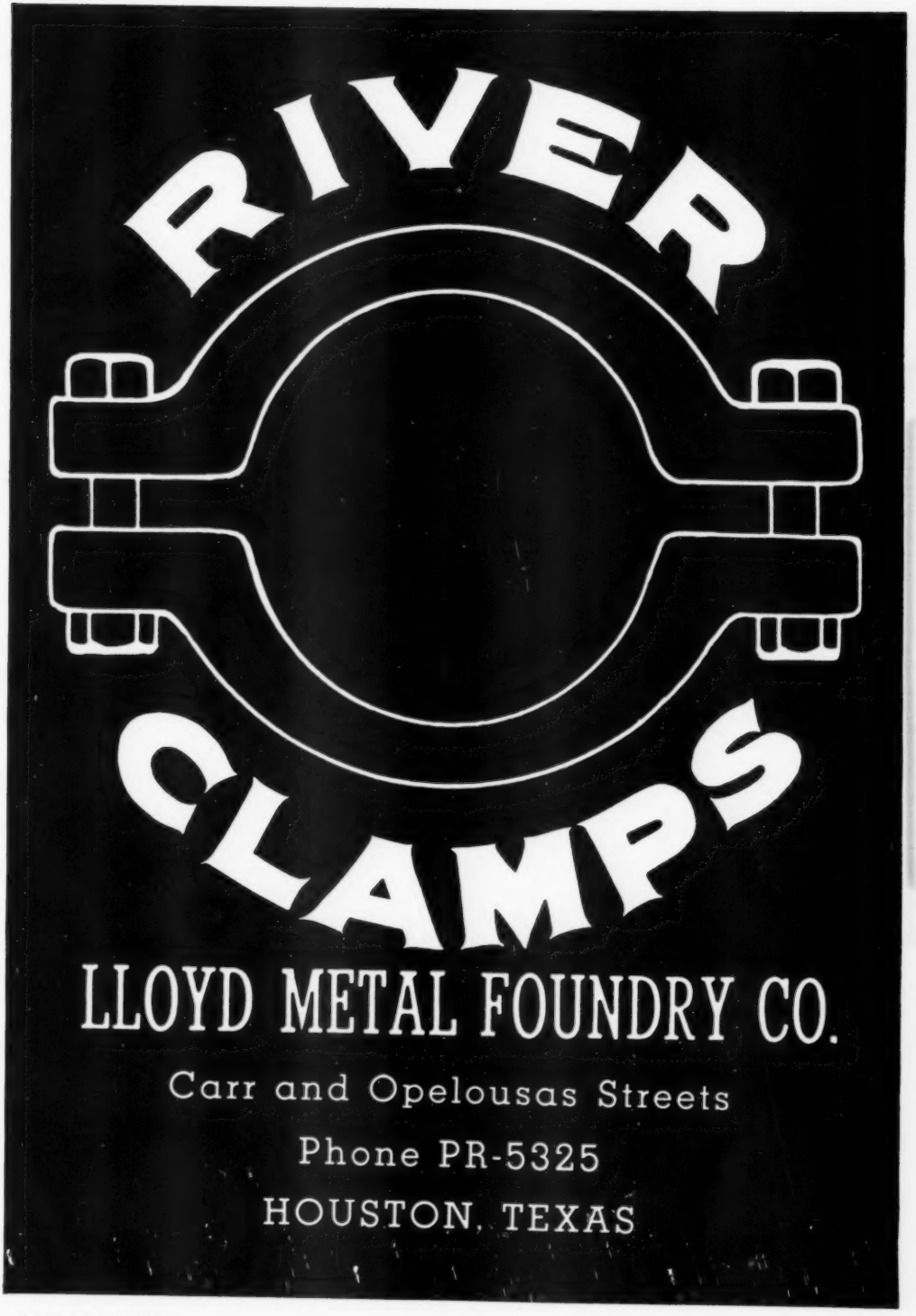
A NEW "packaged" service which incorporates all the important duties in preparation for pipe-line construction is the specialty of an Oklahoma City firm.

This packaged service is carried out by Coates Field Service, offspring of a 50-year-old company, which is equipped to work anywhere in the United States for on-the-spot handling of projects of this kind.

The new system coordinates services and expedites the various related phases of preconstruction operation, and presents the client with preliminary phases packaged preparatory for construction.

John J. Coates, of Coates Abstract Co., is president of Coates Field Service, and Graham V. Taggart is vice president and general manager.

Chief engineer is Paul F. McBride, formerly with United Gas Pipe Line Co.'s engineering department, and right-of-way superintendent is Rene E. Garcia. H. E. York, office manager and comptroller, came to the organization from Chief Drilling Well Co., and J. R. Bowen is superintendent of transportation.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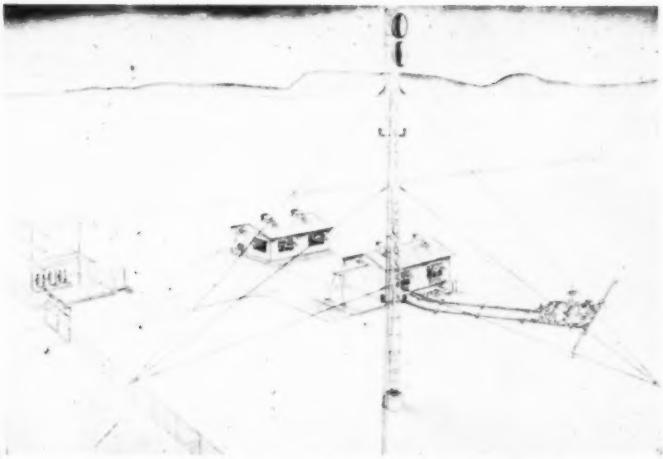
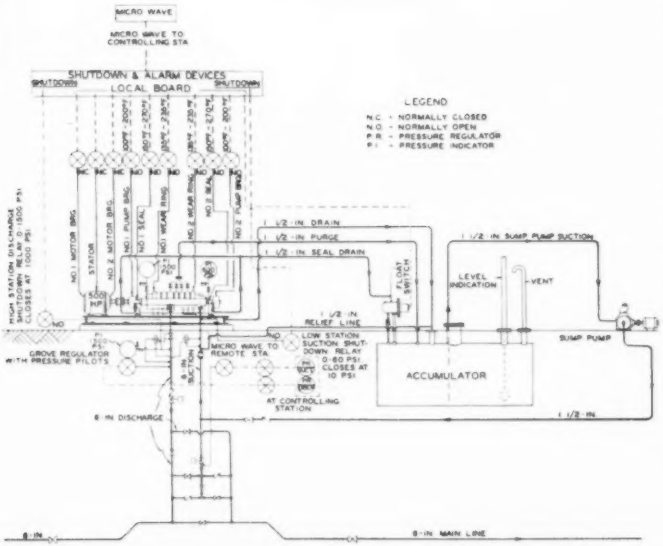


Typical layout of microwave-radio controlled pumping station.

Sunray Pioneers Microwave For Remote Station Control

Facilities being installed in two stations

by J. R. Ellis



Equipment-arrangement diagram of remotely controlled station.

SUNRAY OIL CORP. has experienced a condition which has become quite common in the industry recently—that of pipe-line facilities constructed in the past few years becoming overloaded soon after completion, due to the increasing demand for petroleum products.

In 1947, Sunray constructed and placed in operation a 6-in. pipe line between Allen and Duncan, Okla., to serve the refinery it acquired at Sunray, Okla., nearby Duncan. This line, approximately 97 miles in length, was designed for operation in either direction, moving charge stock (gas oil) into Duncan from the east, and gasoline and distillate blending components in the opposite direction. Diameter of the pipe used in the line was dictated to a large extent by availability of material, which precluded the selection of a size that would have provided additional capacity without the use of excessive power.

Three pump stations were constructed along the line at Duncan, Wynnewood, and Allen, a spacing of approximately 48 miles. Each station was equipped with a six-cylinder 540-hp., 600-r.p.m. dual-fuel diesel engine driving an eight-stage centrifugal pump at 3,750 r.p.m. Operating at a maximum discharge pressure of 1,100 psi., maximum throughput of the line was 17,000 bbl. per day.

It was determined late in 1950 that the capacity of the line would not be sufficient to handle the increasing volume of material resulting from the expanding refining operations at Sunray. Since larger-diameter pipe could not be readily obtained, and looping was not practical for the same reason, it was decided to install booster stations to effect the required increase in throughput.

Semiautomatic Type

Since it was desirable to operate the line with a minimum increase in personnel, it was decided that the new stations would be electric powered, remotely controlled of the semiautomatic type. Electric power was chosen for the stations due to the fact that it lends itself better to remote control, a generally lower initial investment, less general maintenance, and its availability at low rates in the area in which the line is located. The stations are designed for operation without an attendant on duty; however, an inspection will be made once each 24 hours by maintenance personnel.

Station sites were located at points approximately midway between existing stations. Their exact locations were determined by hydraulic gradient of the line, accessibility, availability of power, and to utilize the power available at the existing stations to best advantage.

It was determined that adequate wire-line communication facilities

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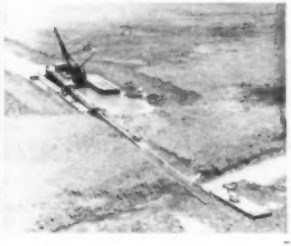
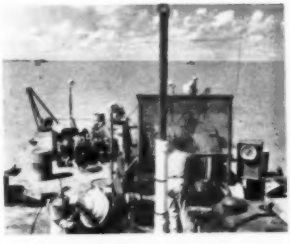


General shore layout for line being laid into Gulf of Mexico.

Part of the 500 ft. ramp where 2 sections of pipe, 5 lengths each, were welded together.



Towing 10,000 ft. sections from ramp to be laid and tied into continuous pipe line to gas well 15 miles out in Gulf of Mexico.

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Three years of work in the Northeast has familiarized Associated with the terrain of New England and the problems involved in constructing lines in that territory.

Associated, in conjunction with J. Ray McDermott, has just completed the longest line laid into the Gulf of Mexico. This 20-inch line, extending 15 miles from shore, is coated with Somastic and concrete.

Crane on barge is lifting 5 length sections of pipe, weighing 50 tons, onto ramp.

ASSOCIATED PIPE LINE CONTRACTORS, INC.

A. L. Forbes, Jr.
President

Earl Allen
Vice-President

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THE AUTHOR

J. R. (Dick) Ellis, vice president of Sunray Pipe Line Co. and manager of pipeline division of Sunray Oil Corp., has been with Sunray since May 1947. He started in the pipe-line industry with Great Lakes Pipe Line Co. in 1934, serving successively as laborer, gager, district clerk, terminal superintendent, and engineer. As field engineer, he assisted in construction of new lines in Kansas, Nebraska, Minnesota, and the Dakotas. He was transferred to Oklahoma in 1947 to construct the line from Tulsa to Allen, Okla., and upon completion of this line joined Sunray.

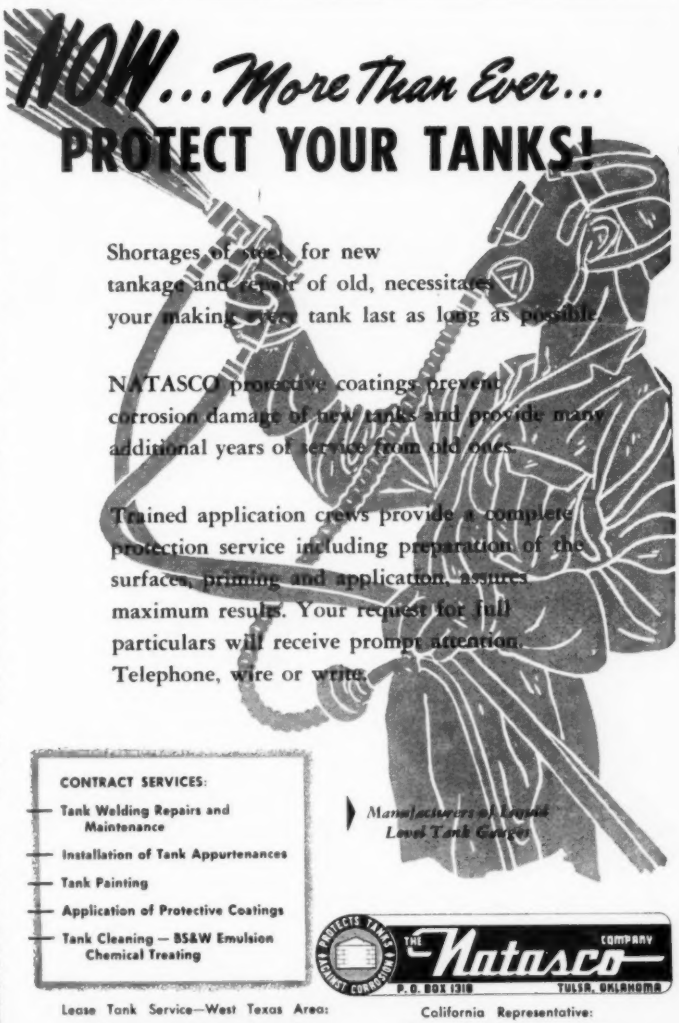
were not available in the area where one of the stations was located, so other means of communication were investigated. A study of recent developments in microwave radio indicated that this facility could be utilized to provide control of the stations. It was found that a multiplex microwave system operating in the frequency range of 960 megacycles would be best suited to the short distances involved. Available data indicated that this comparatively low frequency offered the best circuit due to lower initial cost and subsequent cost of maintaining equipment and reliability and simplicity of the system. Also, due to the propagation characteristics of the waves at this frequency, they are less affected by fading caused by reflection, refraction, and atmospheric conditions than are the higher frequency waves. Sufficient channels are available on this system to meet any anticipated requirements occasioned by future extension to link all of the company's terminals, pump stations, and refineries in the state with the general office to supplement present wire-line facilities. Only three of the seven available channels will be utilized at the present time to operate the remote stations.

Microwave installations are being furnished by Radio Corp. of America. Design and construction of pump stations are being handled by Refinery Engineering Co.

Antenna arrangement.—This equipment consists of a sending and receiving antenna at each of the remote stations mounted one above the other at a height of 100 ft. and 90 ft. at the station near Pernell, and 300 ft. and 290 ft. at the Ada station. At the control station the antenna consisting of a sending and receiving antenna pointed toward each of the remote stations mounted 350 ft. and 340 ft. above ground level. All antennas are of the 4 and 6-ft.-diameter high-gain parabolic reflector type, mounted on steel guyed towers, whose heights were made necessary by the extremely hilly terrain rather than by the distances involved. A topographic survey made between the stations indicates a line of sight path is provided between the antennas. The towers are designed so that the system may be extended in either direction without modification.

Control system.—The two remote stations located east and west of the existing pump station in Wynnewood, near Ada and Pernell, respectively, will be controlled by the operator on duty at the Wynnewood station. A dual console control desk, located at the controlling station office, is equipped with recording charts operated by telemetering equipment. This gives the operator a continuous record of suction and discharge pressures and the kilowatt-hours being used at each location. Indicating lights show operating conditions, equipment failure, emergency generator operation, and radio-tower light failure.

The stations will normally be controlled remotely by the microwave equipment from the controlling station; however, local control can also be obtained by means of a selector switch located at the controlled station. Starting of the stations is accomplished by pushing the start button at the controlled station, or a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start button at the controlled station, dependent upon position of the selector switch. A 110-volt relay at the control station is closed either by microwave carrier impulse from the controlling station push button, or by the manually operated push button at the control station.

Starting sequence.—The motor-operated suction valve opens. When the suction valve is completely open, the main pump motor starts and simultaneously the discharge begins to open. After the discharge valve opens, and the station is on stream, a green light will show on the console at the controlling station.

Stopping sequence.—This is initiated by pressing the stop button at the controlling station or the controlled station, dependent upon the position of the selector switch. The pump motor stops simultaneously as the discharge valve begins to close. When the discharge valve is completely closed, the suction valve begins to close.

The manifolds are designed for pumping in either direction to meet requirements of the connected refineries. The sump pump will be operated manually from the controlled station.

If a suction or discharge valve does not open completely, the station will automatically shut down. If the operating suction pressure is not above a predetermined minimum, or if the discharge pressure is not below a predetermined maximum, the station will also shut down, causing the discharge and suction valve to close in normal sequence. In case of abnormal pressure conditions, the station can be started again by pushing the start button at the controlling station or at the controlled station as soon as the pressure becomes normal.

Pumps and motors.—High temperature on pump bearings, pump case, pump seals, motor bearings, and motor starter will shut down the station. Excessive pump seal leakage will trip a float switch on the sump tank, also causing shutdown. Any of these conditions will be indicated by a red light on the console at the controlling station and a drop flag annunciator at the controlling station. The trouble must be corrected and a mechanical interlock release manually tripped before the station can be set in operation again.

Power.—In case of electrical failure, an automatic transfer panel cuts in an emergency 10-kva. generator. This generator supplies emergency power for the lighting panel and the two motor valves. If the station has power failure during startup, normal operation, or shutdown, the watt meter on the console at the controlling station will register zero and the emergency generator will supply current for normal sequence closing of the motor valves.

When normal power resumes, indicated by the emergency generator stopping, the station can be started by again pushing the starting button at the controlling station. If the emergency generator fails to operate, the indicator light marked "emergency generator running" will not light on the console. When this condition exists, the motor valve must be closed manually before the station can be started under normal power operation. The lighting panel furnishes power for the temperature switches on the motor and pump, float switch on the sump tank, radio equipment, and the telemetering transmitters. Voltage, overcurrent, and undervoltage protection is provided in all circuits.

Buildings and Equipment

Equipment in each of the remote stations is housed in two corrugated transite and steel buildings. One building houses all the control equipment, motor starter, standby generator, and radio equipment. The other building, located approximately 40 ft. from the control building, houses the pump and motor. Two buildings are used to keep all controls at a safe distance from the pump where an explosive atmosphere could

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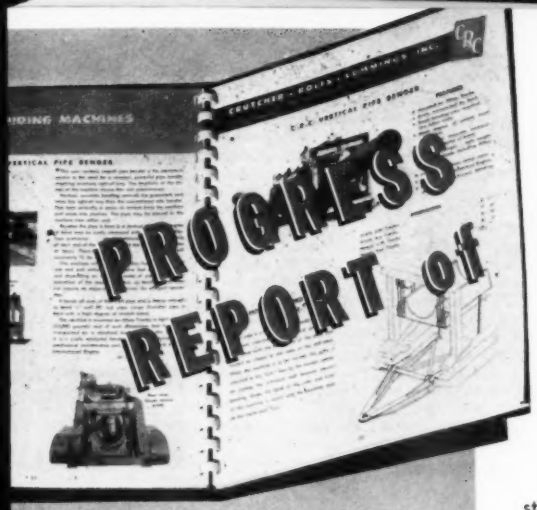

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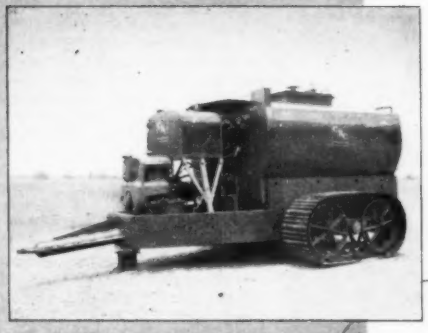

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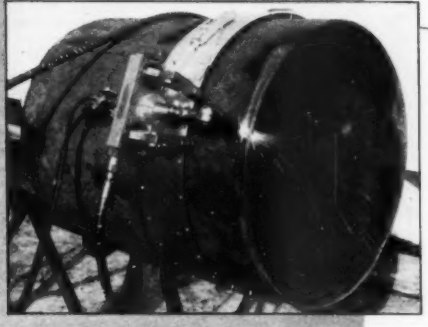

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develop in the event of leakage of the material being pumped.

The pumping equipment consists of a 500-hp., 3,600-r.p.m. explosion-proof motor directly coupled to an eight-stage 4-in. centrifugal pump of the same type as installed in the original stations. The pump is equipped with single mechanical seals and provisions have been made by use of a float switch for shutting down the unit in the event of seal failure.

A dual-pilot-controlled hydraulically operated valve installed in the pump discharge provides throttling control to hold constant pump suction pressure and also operates to prevent excessive discharge pressures. This control is made necessary due to wide variation in specific gravity of the materials pumped. Flow through the stations is controlled by the originating station on the system based on information relayed by the controlling station.

Output of the connected refineries of Sunray Oil Corp. has been at such a high level during 1951 that it has been necessary to install temporary pumping units at both of the remote station sites pending receipt of material that will permit completion of the permanent installations. Operation of these units has permitted an early increase of the line capacity by 33 per cent.

Sunray Pipe Line Co., which operates an 8-in. pipe line between Allen and Drumright, Okla., via Bristow, faced with the same need for increased capacity, is installing a booster station of the same type at a location near Bearden, Okla. This station will be controlled by a microwave radio link from the originating station at Allen, a distance of approximately 32 miles.

Equipment in this station consists of a 700-hp. electric motor driving a 6-in. six-stage centrifugal pump. All other equipment is similar to that installed in the stations on the 6-in. line. It has also been necessary to install temporary pumping equipment at this location pending completion of the permanent station.

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How to Interpret Radiographs

(Continued from page 186)

tically blank indicating a heavy deposit of metal but very little overlap. Voids are indicated in the light section at this junction. Cross-sections (5B and 5B′) taken at this point and facing each other show the extremely high cover bead with severe undercutting, large slag deposits, and a definite lack of penetration. The combination of these defects could be enough to cause a pinhole leak if proper repairs are not made. Grinding of the cover bead to give a density equal to the remainder of the weld would have revealed greater detail of the defects in the radiograph.

The cover bead of the weld in Fig. 8 shows a normal "top button" with a fair weld flow in each direction. Again the root bead is too high for proper penetration and practically no root bead exists.

The radiograph in Fig. 8 shows lack of full penetration and indicates some lack of fusion along the side of the bevel. In measuring the blurred area a width of just $\frac{1}{16}$ in. was found. Assuming a $\frac{1}{16}$-in. lip to the original bevel the depth of this void from the root surface is estimated to be approximately $\frac{1}{8}$ in.

Cross-sections 5A and 5A′ Fig. 8 substantiates the radiographic indications and a measurement of the depth of the defect confirms the estimate with reasonable accuracy, the depth being slightly more.

In the weld section shown in Fig. 9 the cover bead intersects two longitudinal welds and is of proper width and contour although the radiograph indicates that this bead is heavier than desired. The root bead is very rough and incomplete. The radiograph shows this roughness but, except for a short length near one longitudinal seam, shows no real defects.

Cross-sections 8B and 8B′ in Fig. 9 taken at the suspected point show a window partially filled by the second pass, but containing a shrinkage crack

and some lack of fusion on one edge. The two cross-sections face each other, explaining the apparent lack of fusion on opposite sides of the weld.

The cover bead of the welded section shown in Fig. 10 is good with just a trace of undercutting on one side. Root penetration is fair, except at the right-hand edge where several burn-through areas may be noted. The second pass was made with a technique to produce numerous pinholes in the weld as is shown in the photo of this bead.

The radiograph in Fig. 10 reveals a large number of gas and slag pockets at the same edge as the pinholes shown in the picture of the "hot" pass, Fig. 10. This indicates that, where pinholes exist, they will not be entirely removed by succeeding beads and will remain as gas pockets and slag inclusions. The longitudinal section (8a) shows the slag deposit indicated in the center of the weld.

The cover bead in Fig. 11 is very good. Attention might be directed to the arc track next to the weld which is also readily identified on the radiograph in this figure. The root bead in this section is just drawing tight enough together that full penetration can no longer be attained.

The radiograph in Fig. 11 shows the penetration of a root bead, but no indication that lack of penetration exists. More noticeable in this radiograph are the slag inclusions and slag stringer, which occurs as a dark line in radiograph immediately above arc track.

The longitudinal section 7C Fig. 11 shows one of these slag pockets and also a dispersal of gas pockets.

Again in Fig. 12 the cover bead is good. An arc burn next to the weld can also be found on the radiograph, Fig. 12. The root bead shows a number of burn-through areas.

Burn-through areas are shown as very dark spots in the radiograph of Fig. 12, indicating voids of considerable magnitude. The weld is also revealed as containing numerous slag inclusions as shown by the irregular dark areas.

Longitudinal sections 7A and 7A′ Fig. 12 were cut facing each other, one through the windows and the other through the slag-infested section. These sections show the depth of the voids and the accompanying very dirty weld metal.

Cross-sections 7B and 7B′ Fig. 12 were taken, facing each other, through the third window and again show the depth of the void at the center of the window and a shrinkage crack in the second pass near the edge of the window. It is also interesting to note the large slag pocket in the third pass at the edge of the weld with some cold lap in the next pass. This examination shows that the entire weld at this point really consists of only one solid pass and the cover bead.

In the weld section in Fig. 13 the cover pass would indicate a nearly perfect weld. The root pass shows no penetration and in fact a jamming of the metal in alignment of the base plates. The radiograph shows a distinct line indicating lack of fusion at the root. Of particular interest is a distinct blurr at one point which would indicate lack of fusion of some magnitude. Again measuring this blur the depth of the void from the inside surface is estimated to be $\frac{1}{8}$ in.

Longitudinal section 6B Fig. 13 shows general lack of penetration indicated on the radiograph as a straight line with the "blur" actually showing at the end of this section. The cross-section 6A Fig. 13 shows the full extent of the blur and confirms the estimate of the extent of this defect. It may be noted that the effective weld is less than 50 per cent of the wall thickness.

The welded section in Fig. 14 is rather narrow and some undercutting may be found. The root bead is fairly uniform. One small window may be found at the weld edge.

The radiograph in Fig. 14 shows the window to have considerable density, indicating more void than is apparent from visual inspection. The radiograph also indicates some porosity to be found in this section.

Cross-section 12A Fig. 14 shows

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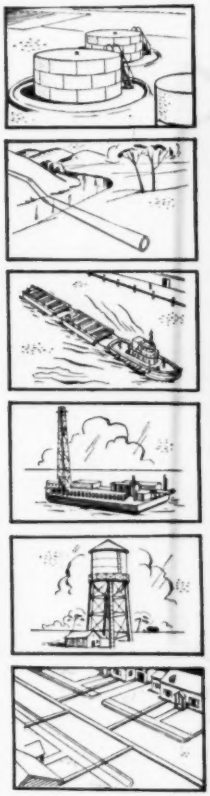

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4½	29,054	658	400
4¾	33,983	590	400
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both the depth of the window with a shrinkage crack in the second bead, and a lack of fusion at the edges of the cover bead. The longitudinal section 12A' Fig. 14 reveals several of the indicated gas pockets, both in the root pass and in later passes.

Both cover and root beads shown in Fig. 15 indicate some undercutting or rivering which are clearly revealed by the radiograph.

The weld shown in Fig. 16 is part of the bottom of a girth pipe weld. The face of the weld shows a complete lack of a cover pass with severe undercutting and a hole which in later investigations is shown to penetrate the weld completely. The root bead contains two windows and is generally undercut and rough.

The radiograph in Fig. 16 shows a particularly rough, dirty weld with two very dark areas, the windows seen in the root pass, and a large amount of slag and severe undercutting at edges of cover pass.

A view of the root bead before the filler beads were applied, Fig. 16, shows the burned metal which the welder produced in passing the bottom center of the girth weld.

The longitudinal section 11B Fig. 16 readily shows the burned-through voids almost penetrating the weld and the generally dirty condition of the deposited metal. The larger of these two voids actually penetrated the weld at the point shown.

A poor cover bead with considerable rivering is shown in Fig. 17. The root bead on the other hand is of excellent quality judging by visual appearance. It might be stated that the two plates were offset by approximately 3/32 in. accounting in part for the poor cover pass.

A fairly sound weld with the root bead near one side instead of center of cover pass and considerable undercutting of depth and width is shown by radiograph in Fig. 17.

The cross-sections 11A and 11A' Fig. 17 show the staggered beads and the lack of cover bead in fusing both edges of the base stock. Some minor gas pockets may also be noted. The root bead is well fused into both sides of the base plates, producing a good fillet.

The welded section in Fig. 17 shows a good cover bead and root bead with one small fold. The radiograph of this weld reveals a dark spot at this fold with the indication of the start of a crack.

Although the crack was not verified by cross-sectioning, the section 10A Fig. 18 did reveal a deep "blow" hole which was not sealed until the fourth pass was deposited, thus penetrating through 50 per cent of the wall thickness.

A very good cover bead intersecting both longitudinal welds is shown in Fig. 19. The root bead on the other hand is very rough between longtiudinal welds. The radiograph of this weld reveals the roughness of the stringer bead, but shows no serious defects.

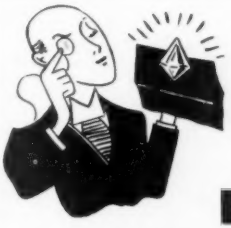
Longitudinal sectioning, 9B Fig. 19, of the rough portion reveals clean metal with all the roughness above the plate surface. Several small gas pockets may be noticed in this section. Cross-section across the suspected crack shows slight burn through with a shrinkage crack through several succeeding passes.

A section of weld in which a crack has been found by X-ray is shown in Fig. 20. The outside bead is acceptable but shows a short patch as is normally made to fill a slight undercut or pin hole at weld edge.

The radiograph in Fig. 20 shows the crack about 3½-in. long at the edge of the stringer bead. The weld deposit on the whole is excellent.

The root bead in Fig. 20 is good with a very slight length of lack of penetration. The crack can be noticed at the edge of the stringer bead between the arrows and leading into the unfused area.

Cross-sections "A" and "B", radiograph Fig. 20, were taken facing each other and approximately ½ in. apart. The crack can be noticed in cross-section "A" following the edge of the weld. In cross-section "B" the crack may be seen to extend into the weld. Cross-sections "C" and "D" were taken outside of the cracked area and show the additional patch weld with small slag inclusions at the root.



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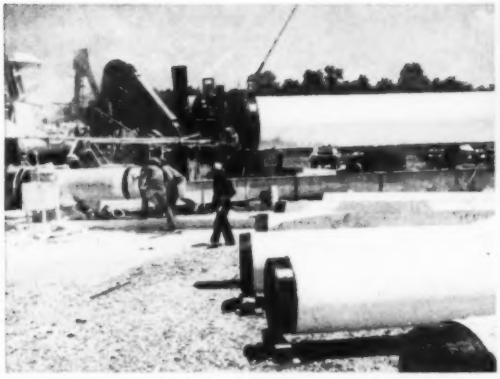
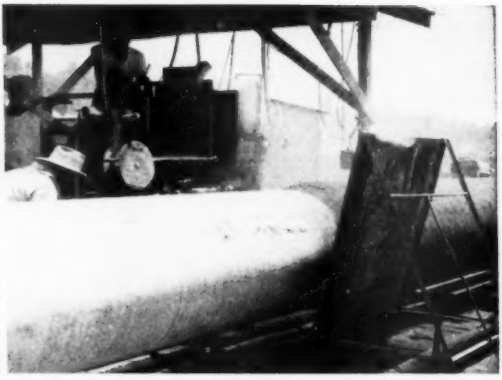
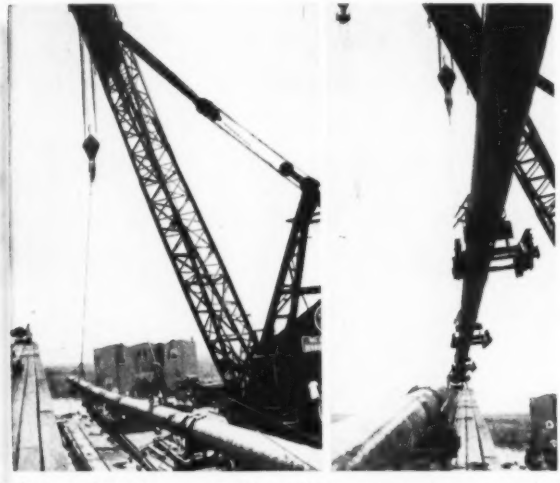


Operations for applying coating on 20½-in. pipe at field plant.



Application of concrete jacketing over coating at Bayou Boeuf yard.



Left: Crane beginning to raise 200 ft. 20½-in. coated and concrete jacketed section from barge which has been towed from the Bayou Boeuf yard. Right: Preparatory to lowering, the crane swings the 200-ft. section toward tracks on the ramp barge to place it behind long section resting on the ramp.

United Lays First Offshore Big-Inch Line

The Journal's pipe-line editor secured the data for this article on an on-the-spot visit during the welding of the last 10,000-ft. section fabricated at the ramp barge prior to being towed to its seaward position.

by Paul Reed

Section raised to point where railroad trucks attached to pipe are clearly visible.

OFFSHORE wells are now being connected by a big-inch system under construction for United Gas Pipe Line Co. This is the first big-inch submarine line ever laid for this purpose. It extends off the Louisiana Coast for approximately 25½ miles on the west side of the Mississippi River Delta. The project is an early part of the program of United comprising more than 1,000 miles which is scheduled for construction in 1951 and 1952.

The current offshore work was planned in two parts: (1) A 15-mile section of 20½-in. from the shore to Pure Block 32 being constructed by Gulf Southern Contractors and (2) a 10½-mile, 14½-in. section from Pure Block 32 to Magnolia Block 51, being constructed by Brown & Root, Inc.

Pipe coating and concreting for

Flanged wheels of trucks placed on ramp tracks as 200-ft. section is lowered.

Closeup of operation showing how railroad trucks are chained to pipe.

the United offshore jobs are done according to practices which are basically similar. All pipe is first coated with Somastic and then concrete jacketed with standard cement. The cement has no weighting materials such as barytes. This standard cement is applied on wire reinforcing. No river clamps or anchoring weights are used.

Since somewhat different procedures are followed in construction the first and second sections of the company's offshore project they will be described separately.

The first section consisting of 15 miles of 20½-in. is part of 58.9 miles of 20, 24, 26, and 30-in., extending to the delta shore from Napoleonville, La., mostly over a marshy route, and from there to Pure Block 32.

Water depth at the seaward end of this section at Pure Block 32 is 17 ft.

The pipe is 20½-in. i.d. with a total wall thickness of ¾-in. This consists of ½-in. pipe wall on which the manufacturer has wrapped ¼-in. steel sheet.

Coating and jacketing operations were performed at Bayou Boeuf, La., where Somastic is applied by the H. C. Price Co. and concrete jacketing by Rosson-Richards, Inc.

Weights of the pipe in the various stages of processing are indicated as follows:

WEIGHT PER FOOT OF 20½-IN. I.D. ¾-IN. WALL PIPE

Bare pipe, pounds	158.19
Somastic ⅝-in. coating, pounds	38.88
Concrete jacketing, pounds	65.64
Total, pounds	262.71

The making of each ¾-in. weld required from 17 to 20 beads. By a program of having welders working in pairs for shifts during 24 hours of the day, an output of 19 welds per day was attained. All welds are inspected by X-ray photographic methods.

At the Bayou Boeuf yard, the coated and jacketed 40-ft. joints were welded into five-joint, 200-ft. sections and then barged to the contractors' ramp barge at the shore end of the submarine line.

Procedure at the ramp barge was first to place a 200-ft. section on small, narrow, railway-type trucks and securely fasten them to the pipe.

After the bare spaces at the ends of the joints were coated, the whole 200-ft. section—trucks and all—was lifted by a crane and placed on the upper end of the ramp in such a way that the flange wheels of the railway trucks rode on the two rails of the ramp. The trucks and rails facilitated sliding the pipe in the water.

By adding one 200-ft. section to another on the ramp, sections were fabricated of an average length of 10,000 ft. These ranged from 8,000 to 20,000 ft. in length. When each long section was completed, the ends were plugged so that the interior would hold air and be dry. Altogether eight separate long sections were fabricated for the total length of 15 miles for the 20½-in. offshore line.

When each section was towed away from the ramp barge, it was floated by 16-ft. pontoons, lashed to the pipe in pairs at 400 to 600-ft. intervals.

A dredge proceeded immediately ahead of the forward end of the pipe to dig channels across the shoals. After each long section reached its location in the 15-mile line, it sank to the bottom after it was released from cables and saddles by which it was fastened to the pontoons.

The long sections remained on the sea bottom until tie-in welding. The procedure for making the tie-in welds is to have derrick barges raise and support the two ends of the sections to be joined. Altogether the pipe is supported in four places by the two derrick barges, a 100-ft. barge and a smaller one.

After the sections are tied in, a trench 8 ft. deep is dredged alongside the pipe into which the pipe sinks to its final position.

The 10½-mile, 14½-in. section from Pure Block 32 to Magnolia Block 51, contracted for construction by Brown & Root, is laid somewhat differently from the job just described, in the following way:

The pipe is Somastic coated and concrete jacketed at a yard at Harvey, La.

The Brown & Root ramp barge consists of a ramp built on an LST boat, which operates entirely at sea. The stovepipe method is used for adding a joint at a time. When the pipe slides down the ramp, the barge is moved farther along to the next position on the pipe-line route.

The entire United project is built under the supervision of Brown & Root, Inc., which has charge of engineering and inspection.

View looking down the ramp of the barge along the rear end of a 10,000-ft. section while final welding and other operations were carried on preparatory to towing it to position on the 15-mile offshore route.

PIPE-LINE CHART:

Weymouth's Gas-Flow Formula

Prepared by R. A. Henson, Gas and Water Department,
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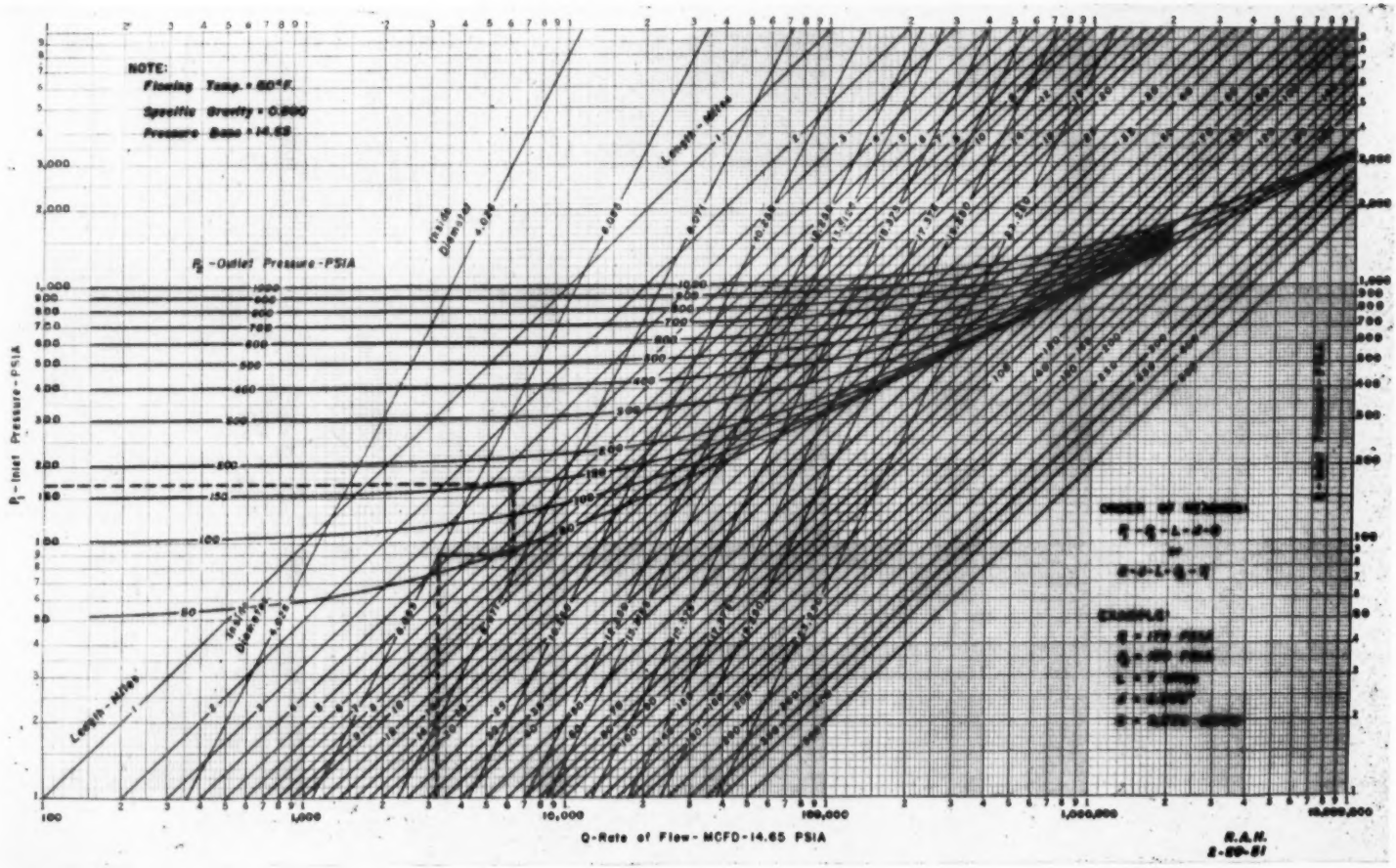

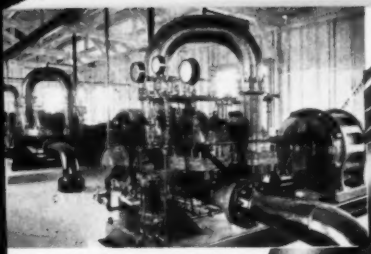

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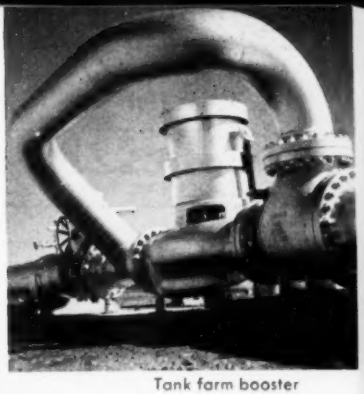

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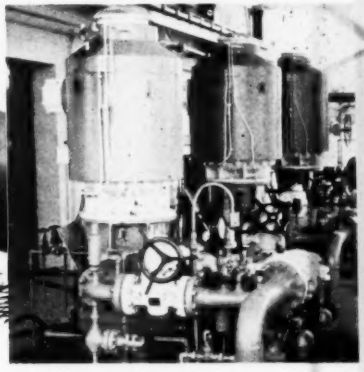

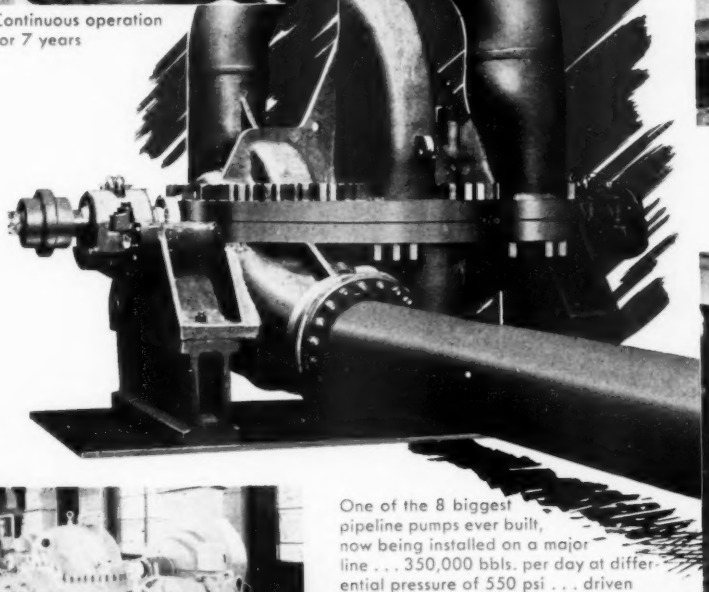

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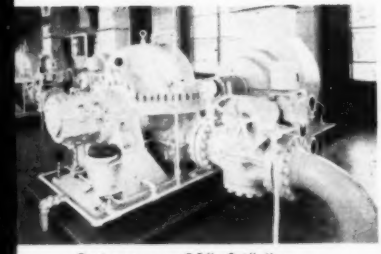

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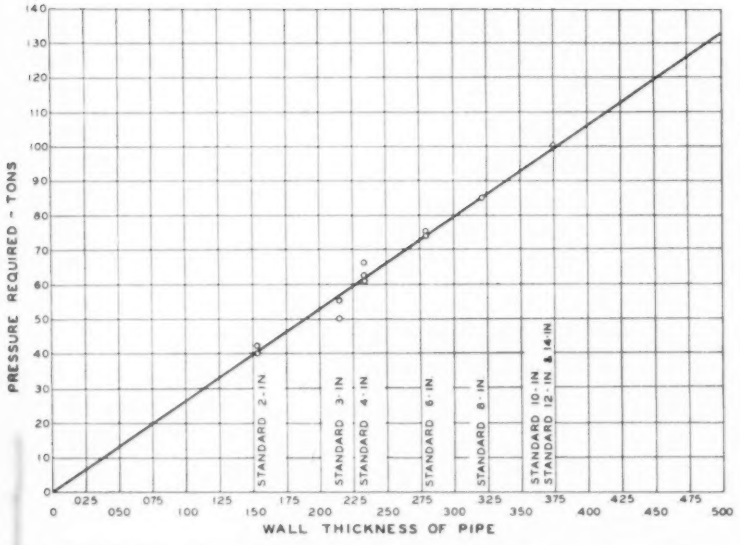

Fig. 1—Graph showing force necessary to collapse pipe of various diameters and wall thicknesses to shut off flow. Data based on using 2½-in. bars with device shown, right.

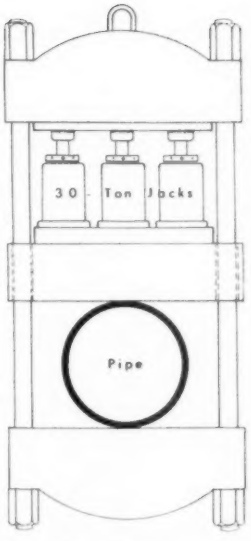

Fig. 2—Pipe-collapsing device designed to exert 90-ton force.

Pipe-Collapsing Device . . .

makes pipe replacement possible without loss of line drainage

by J. D. McConnell

DESIGNERS and constructors of many early-day crude-oil pipe lines seem to have overlooked the fact that pipe replacements would eventually become necessary. Often, gate valves were not provided at low points and stream crossings where excessive drainage would be encountered.

In multiple-line systems drainage presents no problem, because with modern pipe-tapping machines and portable pumping equipment it is a simple matter to transfer oil from one line to an adjacent line. On a single-line system the handling of drainage proves costly and hazardous since the oil is generally hauled away in tank trucks or accumulated in an earthen pit whence it can later be pumped back into the line.

For many years there has been available on the market a machine which mills out a short section of pipe through a gate valve and special fitting welded to the line and effects a closure by means of an expansible rubber plug which can be inserted or removed through the gate valve. This device is not suitable for lines in high-pressure service, however, as the special flanged fitting which remains welded to the line is designed for working pressures of only up to 125 psi.

About 10 or more years ago the writer read a magazine article describing a method used by one of the major pipe-line companies which consisted of pumping hot asphalt into a pipe line at the point where closure was desired; the theory was that the asphalt would congeal on contact with the oil and pipe and form a plug around which oil could be transferred in order to "dry up" the section of line where pipe replacement was necessary. It is understood that the section of pipe containing the asphalt plug was later heated as pumping was resumed through the line, thus melting the asphalt sufficiently to permit passage of some oil. Once the stream started around the plug, the oil would gradually dissolve the asphalt. The writer has heard nothing further concerning this idea and assumes that it did not prove universally succesful.

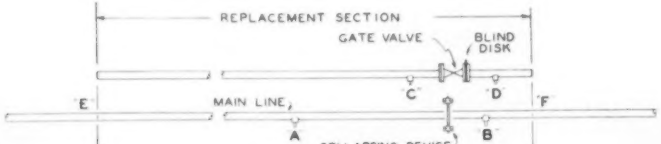

Fig. 3—Operational layout for installing replacement section in pipe line utilizing collapsing method for shutting off flow.

About 9 years ago Sinclair Pipe Line Co. was confronted with the problem of making pipe replacements in several 6 and 8-in. lines at stream crossings and other low points where no block valves had been installed to handle drainage. Pipe in the various lines in question was all known to be Grade "A," or low-carbon steel, so it was proposed to try collapsing or crushing the pipe in order to effect a closure in sections to be replaced.

THE AUTHOR

J. D. McConnell is administrative assistant in the executive department of Sinclair Pipe Line Co., at Independence, Kans. A native of Minnesota, he attended University of Wisconsin, and joined Prairie Pipe Line Co. as junior engineer in 1920. He was transferred to the Tulsa office in 1926 as assistant to division engineer. He left the company in 1932, and 2 years later joined the engineering department of Sinclair Refining Co., and since that date has served in the capacity of district foreman, assistant division superintendent, and assistant chief engineer. He was promoted to his present position last month.

Before any field attempts were made, shop experiments were conducted on samples of various sizes of Grade "A" pipe in a 300-ton hydraulic press, pressure being applied to the pipe through steel bars 2½-in. wide. Results of these experiments were very encouraging and it was decided to go ahead with the field jobs using hydraulic jacks for power. Results of the shop experiments are plotted on Fig. 1.

The first field job was on an 8-in. line at a creek crossing requiring replacement. A 150-ton hydraulic jack mounted in a crude framework made of structural steel was used. A good closure was secured, and the job completed without trouble. Since a 150-ton jack is very heavy to handle and not available in all localities, it was decided to use three smaller jacks and the device for transmitting the crushing pressure to pipe was redesigned as shown in Fig. 2. Reference to the graph, Fig. 1, shows that a pressure of 85 tons is required to completely collapse 8-in. standard-weight Grade "A" pipe. Consequently it has been the practice to use three 30-ton jacks when working on an 8-in. line.

To date this device has been used on at least a dozen jobs and has worked successfully in each case. In the field no attempt has been made to collapse pipe larger or heavier than 8-in. standard weight. No occasion has arisen requiring the use of this method on seamless pipe, but this should present no difficulty, provided it is certain that the seamless pipe is of low enough carbon content to be as ductile as the old Grade "A" lap-weld pipe. In collapsing lap-weld pipe, the apparatus has always been mounted so that either the upper or the lower pressure bar is in direct contact with the pipe seam.

Installing Block Valve

Fig. 3 shows in plain view the setup of a typical job. The replacement section, with future block valve installed is lined up alongside the section of pipe to be replaced, and collapsing device is installed. "A," "B," "C," and "D" are special tap-in fittings welded to pipe. These fittings have a threaded internal flat plug which can be inserted with line tapping machine through a gate valve, thus making possible recovery of the gate valve. The fittings may be welded either to the top or side of pipe, but side installation is preferable for fitting "A" which should also be located at the lowest point on the section of pipe to be replaced, so that all possible drainage can be picked up.

Connections are made to a portable pumping unit so as to take suction on "A" and discharge into "B" after closure is affected with the collapsing device, after tapping into the line at "A" and "B." After all drainage is transferred from "A" to "B," the main line is cut with pipe cutters at "E." It will be understood that flattening of the pipe with the collapsing device does not secure a perfect closure, but any small amount of leakage can be prevented from running into the bell-hole at "E" by mudding off and continuing to run

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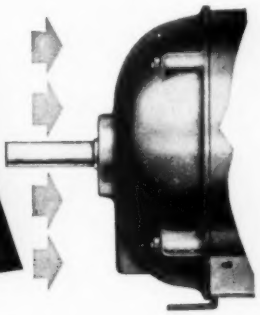

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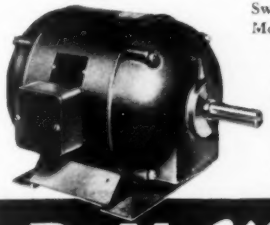

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the pumping unit so as to remove this leakage at low point "A."

After making the cut at "E," this end of the replacement section is tied into the main line. Pump connections are now switched so as to take suction through "B" and discharge into "C." It is a good idea to provide a blind disk on the block gate, as shown on drawing, for insurance against valve leakage when the tiein at "F" is to be made. This blind disk must be replaced with a space ring after the "F" tiein is completed.

When all drainage in line to the right of collapsing device is transferred from "B" into the previously emptied line through "C," the main line is cut with pipe cutters at "F" and this end of the replacement section swung into place for the final tiein. The old section of line containing the flattened pipe can now be pulled out of the ditch and fittings "A" and "B" recovered by cutting off with acetylene torch. Fitting "D" is merely provided for future use in making oil transfers around the block gate.

In recently constructed and proposed large-diameter crude and products pipe lines, block valves are provided at principal stream crossings, but are not economically feasible at all points where line drainage would present a problem. In spite of improved pipe coatings and cathodic protection, pipe replacements will eventually become necessary and many such jobs will present terrific headaches. For instance, the drainage from just 1 mile of 24-in. pipe is approximately 2,800 bbl. The pipe-collapsing scheme will not work as the pipe in these lines is too hard and brittle to stand flattening without cracking.

Furthermore, the scheme has the disadvantage of requiring permanent installation of a costly valve. If in the meantime, some inventive genius should produce a relatively inexpensive and simple device for effecting a line closure against hill-pressure, it will certainly be welcomed by the industry.

Remote-Reading Gauges

(Continued from page 193)

24 and a 30-in. pipe line (the latter new in 1950), each about 2.6 miles long. In the tank farm there existed prior to 1950, four 140,000-bbl. and two 135,000-bbl. floating-roof tanks. In 1950 four new 150,000-bbl. floating-roof tanks were built to handle the increased throughput in connection with the 18-in. second line program.

Tankers discharge with their own pumps from the pier through either the 24 or 30-in. lines to the tank-farm tanks, or into the tanks located at the terminal near the pier. Cargoes which are received into the tanks at the pier are later transferred with the terminal pump station to the

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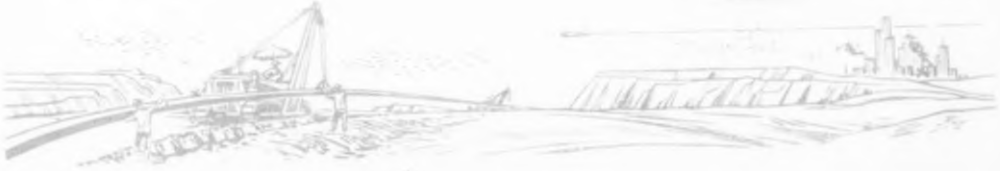

main tank farm through either of the two connecting lines, before being pumped to the main line. Tank-farm tanks are manifolded for receiving oil from either of the two lines from the terminal or supplying oil to either the 12 or 18-in. trunk lines through the main pump station, except that at present the new tanks constructed in 1950 can supply oil to the 18-in. trunk line only.

All tank-farm manifold valves for receiving oil from the terminal or supplying oil to the main line are motor operated, with push buttons located on a piping diagram on the panel board in the main-line pump-station control room. The electrical circuits from the remote-reading gages which are the subject of this article are wired up to the same panel board so that tank gages can be read in the control room.

First Trial Installations

In 1948 the first trial installations of remote-indicating gages were made in Tanks 10 and 11 (each 140,000 bbl.) at the main tank farm. They consisted of bringing the gaged tape in through a 2-in. pipe through the shell of the tank about 18 in. above bottom. At the end of the pipe 2½ ft. in from the shell was located a sheave over which the tape ran upward to a float which rode in a well in one of the pontoons (see Fig. 1). This type installation had proved successful elsewhere for remote gaging of floating-roof tanks in product service.

For a while this arrangement worked well but as bottoms built up in the tank, waxy material was drawn into the pipe and the transmitter housing and prevented the tape and float from traveling. Trials were continued on Tank 11 after cleaning out the wax. A small pump was arranged so as to take suction from just beneath the bottom of the floating roof in its lowest full-float position. This pump circulated oil from just beneath the roof down through the transmitter mechanism and back into the tank through the pipe containing the tape so as to keep it washed out with clean oil. Eventually, however, in the colder months waxy bottoms built up to such a high level (about 4 ft. 6 in. above the tank bottom) that circulation of clean oil could not be maintained and the tape and transmitter again became clogged.

With the same installation an attempt was made to keep waxy material from being drawn in or from flowing into the transmitter by filling with Prestone the transmitter and the riser pipe from it to the counterweight pulley as well as the counterweight well. The Prestone did not, however, prevent the waxy material from being drawn in by the tape and contaminating it to the extent that operation could not be maintained with high bottoms in the tank.

During periods when the remote-gage installation in Tank 11 was working fairly well, certain discrepancies were noticed between the hand gages and the remote-gage readings.

The pipe holding the tape sheave near the tank bottom had a triangular steel plate bracket attached to the shell. It was suspected that part of the discrepancy might be caused by deflection of the tank shell, allowing this lower sheave to move up and down slightly as the liquid level in the tank changed. Definite proof of a significant movement which would affect the automatic gage readings was obtained by attaching a rigid extension to the bracket on the outside of the tank which supported the transmitter, and observing the vertical movement of the outer end of this rigid extension with a scale. The vertical deviations and corresponding errors in automatic gage readings for given liquid levels in the tank correlated closely on several sets of observations on tank filling and emptying cycles.

In 1949 the installation in Tank 11 was again revised and an entirely different type of installation was tried in the other tank, Tank 10, so that two simultaneous tests could be carried out. In Tank 11 the tape was arranged to enter near the bottom as before, but the ends of the pipe and sheave were enclosed in a "pot" having a conical top with a small opening in its apex for the passage

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of the tape. This pot and the piping to and including the transmitter were filled with Prestone (see Fig. 2). It was hoped that, the Prestone being heavier than the bottoms, it would prevent the bottoms from entering the pot and displacing the Prestone through the small opening for passage of the tape.

The pot was weighted down with concrete and a flexible connection was installed between it and the pipe which passed out through the shell so that the tape sheave inside the pot could be maintained at a fixed distance above the bottom regardless of any deflection which might occur in the shell. Put in operation in November 1949, this arrangement worked well during the first few winter months. As the bottoms built up in the tank further, however, readings from the remote tank gage did not check the hand gages very closely and finally about March 1950 it was impossible to get remote-gage readings because of too sluggish operation caused by the wax on the tape.

When this installation was dismantled in July 1951, the transmitter sheave housing through which the tape traveled was full of wax, the tape was gummy, and the magazine housing was half full of wax. The pot still had good Prestone in the bottom half, but the top part from 6 in. below the pipe entrance to the top was full of bottoms material having the consistency of cup grease.

Pipe-Well Installation Successful

At the same time that the conical top "pot" was placed in Tank 11, a 24-in. vertical pipe well was installed in Tank 10 so that the tape could pass overhead and down to a float traveling in the well (see Fig. 3). This pipe well was provided with 1½-in. threaded welding inserts to give openings spaced about 3 ft. apart vertically so that the level of the oil in the gage well could equalize with that in the tank when the tank contained a starting gravity different from that of the oil being received.

To install the 24-in. pipe well, holes were cut in the top and bottom plates of the pontoon through which it was to pass and the pontoon sealed with a 3-ft. i.d. steel-pipe section formed out of steel plate. This pipe section projected above the top of the pontoon so as to form a level surface on which a ½-in. flat steel plate having an elongated hole could be mounted (see Fig. 4). On top of this steel plate is a brass plate having a 2-ft. 1-in. circular hole. This gives ½-in. radial clearance around the outside of the pipe well, except where the hole in the brass plate is enlarged so it can pass by the threaded welding inserts. Threaded openings were used so that if it ever becomes necessary to close the openings, screw plugs can be installed.

Also on top of the steel plate two guide rollers of brass are held by brackets against the 24-in. pipe well (see Fig. 5). These guide rollers allow the 24-in. pipe to assume the function of the original vertical guide bar inside the shell of the tank, which was removed.

The top of the well is covered, and the tape and sheaves from this point to the transmitter are entirely enclosed and well protected from the elements. Pipe from the transmitter to the top of the tank which contains the tape is filled with Prestone and water to keep condensation from collecting because it might freeze and hold the tape in cold weather. The tape is not subject to errors due to wind, or due to currents in the oil entering or leaving the tank.

Fig. 6 shows the lower end of the pipe well. Figs. 7 and 8 are general views of a typical installation. Fig. 9 shows the pump station control center, with the remote-reading gage panel just to the right of the vertical tank-farm diagram.

The installation in Tank 10 worked very well during the winter of 1949-50. It has been continued in service and still works well. Similar installations were therefore made on the four new 150,000-bbl. floating-roof tanks built in 1950. This summer, 1951, the five remaining older tanks at the main tank farm, including Tank 11 on which the other trials were made, were taken out of service and equipped the same way.

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tank-farm gaging costs effected by the automatic gages would be difficult, and will not be attempted as the result would not be of significance for comparison with possible savings in other tank farms. However, a step-by-step description of routine gaging operations and a calculation of the reduction in the number of hand gages required should be of interest. Now that all 10 tank-farm tanks are equipped, in our particular operations, automatic gages reduce the manpower requirements and yield other benefits, tangible and intangible, in addition to making the work to be performed by the gagers less arduous and hazardous. Operations with the automatic gages, and the related reduction in manual gage requirements which has resulted, are described below:

1. **Hourly trunk-line checks.**—With the two trunk lines operated as separate systems, there are always two working tanks which must be gaged every hour. In a 30-day month this would require 1,440 tank climbings and manual gages. All are now obtained remotely in the control room with the exception of one morning stock gage which is obtained manually on each working tank. This gives a reduction to 60 hand gages per month, with 1,380 tank climbings for gaging eliminated.

2. **Daily stock checks.**—There are 10 tanks at the main tank farm, and a morning stock check is required on all tanks. Stock checks on the main-line working tanks are made by hand as explained under Paragraph 1 above. The checks on the remaining eight tanks are required on a net oil at 60° F. basis only on the morning of the first day of each month, so on the other days of the month, when a check is required on a gross fluid basis only, these tanks are read remotely. This is a reduction from 240 to 8 tank climbing and gaging operations per month.

3. **Use of tank-farm receipts.**—As mentioned previously, there are two large lines about 2.6 miles long from the terminal to the tank farm. These remain full of the crude which has been discharged previously by tanker, or which has been transferred from a terminal tank. Crudes are handled on a strictly segregated basis, so the next tanker to use a line must displace this fill into the same tank in which the main part of the preceding cargo was received, before the tanker is cut over to the tank into which its cargo is scheduled. Discharge rates on tankers vary roughly from 2,500 to 25,000 bbl. per hour, so the times required for displacing the line fills which approximate 7,200 bbl. minimum for the 24-in. line, and 12,100 bbl. maximum for the 30-in. line, vary tremendously for different tankers.

On line-fill cutoffs before the automatic gages were in use, a tank climbing was required shortly after the tanker started, to obtain gages about 5 minutes apart to determine

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the discharge rate. Another tank climbing was required about 15 minutes before estimated time of completing the line displacement, and the gager had to stay on the tank for at least this length of time on an average, no matter what the weather conditions, to make additional checks and then give a 5-minute standby notice, followed by the tanker shutdown notice, to another man on the ground who telephoned these notices to the dock personnel who passed them on to the tanker pump man. Following the displacement, after the tanker started discharging again, a gage was taken about an hour later in the tank in which the cargo was being received. Thereafter gages were taken every 4 hours until 40-ft. innage was reached when hourly gaging was resumed so that any increase in the discharge rate would be detected and thus avoid overfilling the tank. A hand gage was also made by the shift gager shortly after completion of discharge. A similar procedure was required on receipts from the terminal when a cargo was being transferred by the terminal pump station to the tank farm, except that line displacements were gaged at the terminal.

Nearly all the tank climbing for gaging mentioned above in connection with tank-farm receipts has been replaced by automatic gage readings in the control room. The gager himself gives the telephone standby and shutdown notices to the terminal or dock. This eliminates having an extra man called out, or held over from his regular work, to relay these notices. One gager can now handle two line displacement or topping-off operations which are proceeding simultaneously which otherwise would have required an additional gager to handle the second operation.

The shift gager will continue to obtain a hand gage on a tank shortly after a tanker or the terminal has finished pumping a line displacement, a cargo, or part of a cargo into it (not for official, but for checking purposes). For 1951, tanker arrivals are averaging 27 per month. With about 10 of these being supertankers requiring 2 cargo tanks each, approximately 64 hand gages per month on tank-farm receipts will be required with automatic gages in use. Without automatic gages, an average of 9 tank climbings per tanker or 243 per month would be a conservative estimate.

4. **Other advantages.**—Any time that intermediate gage readings are desired for any reason, such as a quick check on the opening or closing gage on a tank, for estimating lost throughput after a power failure(the gages in use do not require resetting after restoration of power), etc., they can be obtained by dialing the tank and pushing the reading button. Although the control room contains recording flow meters, the automatic gages give a quick and accurate second check on main-line pumping rates when flow adjustments are being made, or when the flow meters are out of operation (as when the orifice plates are raised for dispatching scrapers).

Benefits Obtained

Table 1 compares:

Column (A) showing average manual gaging work required of the shift gagers and related statistics for the years 1946 to 1949 inclusive. During this period there was but the one 12-in. trunk line in operation, throughput was lower than at present, and there were only six tanks at the main tank farm.

Column (B) showing the same information for average 1951 operations, with the second (18-in.) trunk line in operation, as they would have been with no automatic gages in use.

Column (C) showing the same information for 1951 operations, with all tank-farm tanks equipped with automatic gages.

From the table it can be seen that had automatic gages not been installed, to keep the 1951 shift gagers' work load about the same as it averaged during 1946-49 would have required two gagers on each shift. An extra man or men would still have been required temporarily from time to time for simultaneous line displacements and for line displacements occurring at times when the second

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gager was occupied with hourly checks or stock taking.

We feel that the following benefits are being or have been obtained:

1. **Good employe morale.**—With some automatic gages in operation last winter, the season when hand gaging is most difficult and hazardous, there was but a slight over-all average increase in the shift gagers' duties despite increased throughput. Knowing that the other tanks would be similarly equipped this summer, good employe morale was maintained during the transition period by having a second gager temporarily on the day shift only.

2. **Now prepared for increased throughput.**—With all tank-farm tanks now equipped with automatic gages, further increases in throughput can be handled without increasing the work load above the 1946-1949 level.

3. **Reduction in direct labor costs.**—The need for an additional gager on each shift having been eliminated, the immediate payroll savings are considerable, and more than offset depreciation, maintenance, and operating costs for the automatic gages.

4. **Intangible benefits.**—There are several of these, among them:

(a) The shift gagers' exposure to accidents has been greatly reduced.

(b) A large proportion of physical exertion has been eliminated.

(c) Physical discomfort during bad weather has been minimized.

(d) More time can be devoted to the efficient handling of paper work and records.

(e) More accurate routine measurements on working tanks are obtained.

(f) Routine information and special gages can be furnished to dispatching department more rapidly.

On working tanks it is believed that more accurate gaging results with the automatic gages, for the reason that the gager is in the control room where correct time can be read from the station clock.

Not Used for All Purposes

Opening and closing gages on tanks for calculating receipts from tankers where change of custody is involved require climbing the tank and obtaining not only a hand tape gage but temperature readings and sampling for determining gravity, b.s. and w. content, and net oil at 60° F. These hand gages are used as the official readings. Also, oil is charged out to the trunk lines as gross oil at 60° F. This requires climbing to obtain temperature measurements prior to the opening of each tank for pumping and after closing out to the main lines. Hand gages are still taken and used for these openings and closings, as well as for determining stock on hand at the beginning of each month.

Hand gages for these purposes (being in still tanks) amount to little more than the hand gaging which might otherwise be required for checking the automatic gages to assure their remaining at all times in perfect adjustment, and do serve as such a check.

The two terminal tanks near the pier are not worked as much as those at the tank farm, being filled only when there is not room at the tank farm for receipts. There is always a pumper-gager on duty at the terminal pump station. Since this pump station is equipped with low-head centrifugal pumps which require a minimum of monitoring during operation, and allow time for him to handle the relatively small average amount of gaging required on the two tanks, automatic gages are not planned for this location.

The remote-reading gages used by Portland Pipe Line Corp. are those manufactured by the Telematic Corp., Chicago. The details of the 24-in. pipe well installation were worked out in cooperation with Chicago Bridge & Iron Co. who did the erection work on the wells for all tanks. Motor operators on the tank farm manifold valves were supplied by the E-I-M Co., Inc., of Houston.

The following members of Portland Pipe Line Corp.'s staff collaborated on the details of the installation and several of them participated in the preparation of this article:

C. D. Batchelder, chief engineer, G. D Champlin, vice president; J. L. Creed, general superintendent; L. Fennel, terminal and tank-farm superintendent; C. L. Goodwin, corrosion engineer, and H. L. Phillips chief gager.

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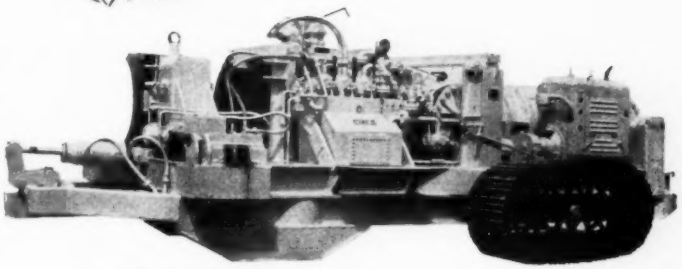

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IT PAYS TO CONTROL

by Lenard C. Hill

KANSAS-NEBRASKA NATURAL GAS CO., INC., built in 1936 a completely new natural-gas-transmission system and several distribution systems. The system at the time was supplied by natural gas from fields near Otis, Kans., and was serving purely agricultural communities in western Kansas and Nebraska. The basic plan for the new system was for transmitting natural gas through relatively small lines at high pressures. Although construction methods have since changed considerably, the basic principles still apply. The original lines were of high-carbon-steel, thin-wall, pipe and Dresser coupled. The sections of line, especially where the pipe was laid in wet land with changing water zones, were coated by hand with a cold-applied coating where the traversed areas were believed to be corrosive.

Corrosion problems came early and abruptly in the Platte Valley in Nebraska. In fact, 14 months after completion of the line a blowout occurred that resulted from severe corrosion. By 1938 pit-leak repairs in the most corrosive areas were common. Prior to 1938 three engine generator and one windmill generator were providing cathodic protection for approximately 15 miles of line east of North Platte, Neb. By early 1939 eight more windmill generators were placed into service on another 15-mile section west of North Platte.

Meanwhile, pit leaks were on a rapid rate of increase on the unprotected sections of line in the Platte Valley while new pit leaks showed a decline in the protected sections. In 1939 a reconditioning and cathodic protection program was set into motion on about 40 miles of line in unprotected sections. By 1941 approximately 40 miles of line was completely reconditioned. Another 30 miles of line in the Platte Valley was bonded; engine generators, windmills, and rectifiers provided cathodic protection. Thirty-four miles of the reconditioned line was coated, some by hand and some by machine, with an asphalt enamel, and wrapped with an asbestos felt. Two sections of the reconditioned line were painted with a cold-applied asphalt paint which became practically ineffective in approximately 5 years.

The 40 miles of reconditioned line was immediately furnished with cathodic protection and to date no corrosion leaks have developed. In other words, the line was practically inoperative in 3 to 5 years without cathodic protection, and with cathodic protection the reconditioned line has developed no leaks after 10 to 12 years. The pit-leak rate declined on the bare line to which cathodic protection was originally applied. It is still in service after 15 years with only an occasional new pit leak.

Present-day design requires all major transmission lines and all company-owned distribution systems to be coated with a coal-tar enamel and glass wrap, fortified with cathodic protection. Rectifiers and magnesium anodes are preferred for cathodic protection and only under very definite requirements are windmills and engine generators considered. In our early bare pipe-line construction, we spot coated the line at hot spots, but we have since concluded that hot-spot coating on a bare line is not entirely practical.

Construction Procedure

On the main-line construction our pipe lines are now of welded construction, coated with 3/32-in. of plasticized coal-tar enamel with a wrap of glass and kraft paper. The coating and wrapping is done by line-travel equipment and the line is lowered directly into the ditch; only when conditions require is it lowered from skids. The ditch is conditioned ahead of the coating procedure by drags on the ditching machine that flattens some of the spoil from the digging wheel. Ditch hands remove occasional clods and build support pads, about every 15 to 20 ft. depending on necessity, in the bottom of the ditch to support the coated pipe.

In western Kansas and Nebraska the soil is ordinarily a mellow sandy clay soil wth very little rock. Felt wrap is not considered necessary as the soils are not of a nature to create severe soil stressing of the coating. The coating inspection consists of a thorough visual inspection by a qualified man and frequent checks with a holiday detector to determine defects of application or material that may be corrected. Good bond, correct coating thickness, and glass penetration are carefully checked as well as travel speed of equipment, kettle procedure, and cleaning and operations.

Assuming that perfect coatings may not be obtained or at least maintained long in good condition, we feel that a coated line should be also provided with cathodic protection and that added amount that might be spent of more elaborate coating procedure than we now use could be used to more advantage or economy by providing cathodic protection. Good coatings have been obtained by our coating procedure. Cathodic protection costs are considered low. Even reconditioned lines coated by this procedure and furnished with cathodic protection, show no corrosion damage after several years' service in corrosive localities. During construction all laterals and taps are insulated from a main line by insulating flanges or bushings and all town systems are insulated from the laterals by insulating flanges. Consequently the cathodic protection later applied may be installed and adjusted to do the specific job intended.

Town Distribution Systems

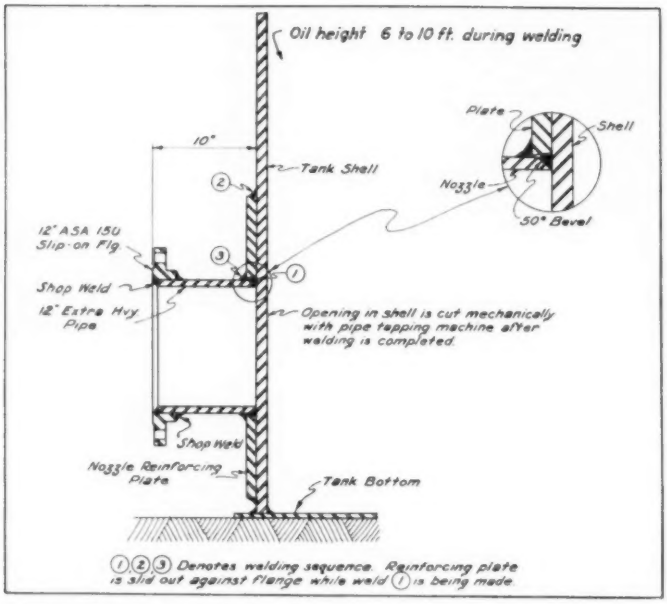
The construction practice for new town distribution systems calls for all welded steel pipe and coated with plasticized coal-tar enamel with one glass wrap and kraft wrap. All service stubs are welded with bent risers or welding fittings and coated with glass wrap and kraft wrap. No sleeves or threads are used underground. All meter loops are insulated on the upstream side of the loop with insulating flanges in case of the larger meters, and by phenolic insulating bushings on the smaller meters. Mill-coated or yard-coated pipe is used on all town distribution work or short change-out jobs. During the time of construction magnesium anodes are installed to provide cathodic protection to the distribution system.

Anodes are not generally grouped

(Continued on page 291)

THE AUTHOR

Leonard C. Hill is corrosion engineer for Kansas-Nebraska Natural Gas Co., of Hastings, Neb. He studied chemical engineering at Oklahoma A. & M. College and commenced corrosion-control work for the company in 1938.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Shell
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Tank Shell
Nozzle
50° Bevel
12" ASA 150 Slip-on Flg.
Shop Weld
12" Extra Hvy. Pipe
Opening in shell is cut mechanically with pipe tapping machine after welding is completed.
Shop Weld
Nozzle Reinforcing Plate
Tank Bottom
1 2 3 Denotes welding sequence. Reinforcing plate is slid out against flange while weld 1 is being made.

Fig. 1—Diagram of 12-in. nozzle installation on tank containing oil during welding.

How to Install 12-In. Nozzles On Tank Filled With Oil

by R. M. Carter

The method described here is an adaptation of the familiar one of tapping a pipe line under pressure, as applied in pipe-line work

A METHOD for welding new nozzles into large crude-oil tanks and tapping the openings through the shells without first draining and cleaning the tanks was successfully carried out recently by Service Pipe Line Co. The method is applicable where larger size, or additional connections are required for a tank in service. It is particularly applicable where there is not sufficient need for other alteration or repair work to justify cleaning the tank. In such applications a substantial saving in cost and time is afforded as compared with the conventional operation of removing the b.s and w. and vapor-freeing the tank for safe use of oxyacetylene flame-cutting equipment.

This method is an adaptation of the well-known one of tapping a pipe line under pressure. As applied in pipe-line work, method involves a tapping nipple welded to the line, a gate valve installed on the nipple, and a special machine for operating a boring bar through the gate and nipple to cut a hole through the pipe wall.

A typical tank nozzle for installation by this method is illustrated in Fig. 1. The design follows A.P.I. specifications except for weld-joint detail between the pipe nipple and tank shell. Normally the pipe would extend through the shell, but in this case it is butted against the shell since the hole in the shell may not be cut until after the welding is completed.

The accompanying photographs, Figs. 2, 3, 4, and 5, were taken during the installation of a 12-in. nozzle on an 80,000-lb. riveted cone-roof tank located near Humboldt, Kans. In Fig. 2, the nozzle has been placed against the shell and is being aligned and leveled preparatory to being tack-welded in position. In Fig. 3, the 12-in. pipe nipple is being butt-welded to the shell. The loose reinforcing plate has been slid out against the flange to make the joint accessible for welding. Fig. 4 shows the reinforcing plate welded to the shell

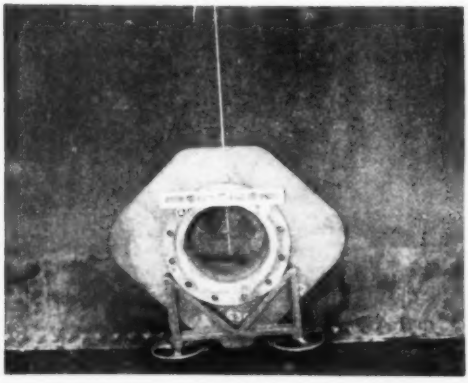

Fig. 2—Nozzle is leveled and ready for welding.

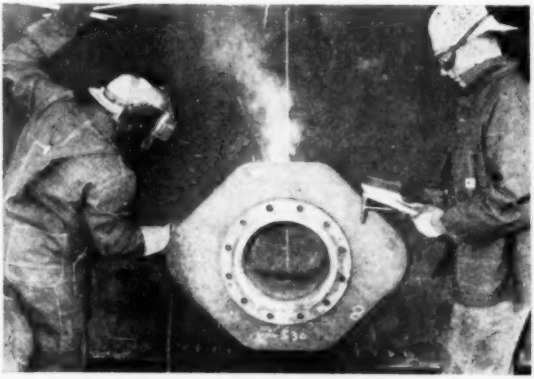

Fig. 3—Beginning of welding operation.

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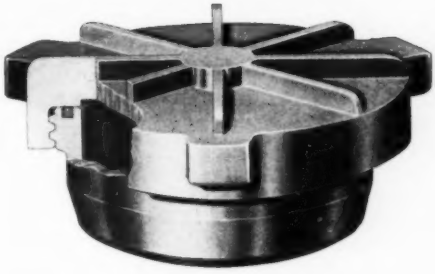

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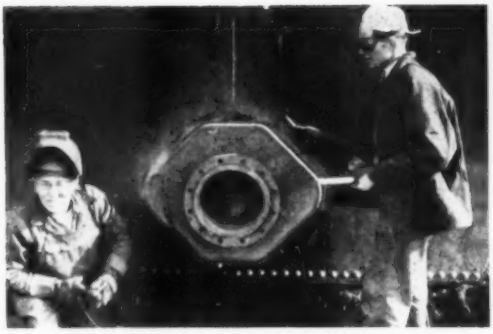

Fig. 4—Welding of nozzle is completed and waiting for gate valve.

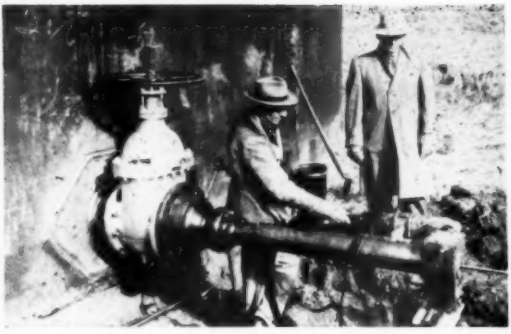

Fig. 5—Operation of tapping machine.

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THE AUTHOR

R. M. Carter, tank superintendent, Service Pipe Line Co., began with Stanolind Pipe Line Co. in the field 18 years ago. In 1937 he became administrative assistant to A. M. Hill, superintendent of line maintenance. He was promoted to his present position in 1949.

around its outer edge. The next and final welding step will be to weld the plate to the nipple.

Fig. 5 shows the tapping operation in progress. A 12-in. gate valve in open position has been connected on the new nozzle and the pipe-tapping machine has been bolted to the valve's outer flange. The machine is equipped with a traveling boring bar which is rotated and traversed by an automatic mechanism powered by an air motor. A rotary, 11½-in.-diameter cutter head on the end of the boring bar has been fed through the open gate and is cutting the hole in the tank shell plate. When the shell is pierced, oil will flow into the body of the valve and machine where it is contained by a packing gland around the boring bar. As soon as the hole in the shell is cut out the boring bar will be retracted to withdraw the cutter to a position within the bell-shaped adapter between the gate and machine, the valve will be closed, and the machine removed.

A salient feature of the operation is the act of welding on a tank containing crude oil, which at first glance may appear hazardous and certainly would be except when performed under selected conditions and controlled procedures. An individual study of any given tank and its surroundings would be necessary to insure having safe conditions at the time of welding.

The oil level in the tank must be well above the highest point of welding on the shell so that the liquid body may dissipate the heat of weld-

ing and exclude explosive gas mixtures from the heat zone. At the same time it is desirable to have the oil height as low as possible so that the loading stress on the shell may be reduced substantially. Not less than 6 ft. nor more than 10 ft. of oil is considered a practical limitation on tanks 30 or more feet in height. On floating-roof tanks the roof should be floating, which usually is the case with 6 or more feet of oil.

Tests should be made to ascertain that the welding area is gas free. This may be done with suitable instruments plus a visual inspection. A well-maintained and properly equipped tank may present safe welding conditions. On the other hand a tank with leaky seams, or having vents without snuffers or flame arrestors, or oil-soaked soil on the grade would not be safe.

Accidental puncture of the shell would be a remote possibility with a skilled operator. In fact, it would be difficult to deliberately force the electrode through the heavy shell plate with an oil coolant on the opposite side. But should the shell be pierced, the resultant jet of oil would be small and at low velocity, assuming that the head of oil in the tank is kept within the limitations previously mentioned, and could be controlled at little risk.

It Pays To Control Corrosion

(Continued from page 287)

but are distributed throughout the system. Anode locations and depth are spotted by making soil-resistivity measurement and a consideration of the pipe area to be protected. If care is taken to avoid accidental contact to other structures and buried metals, the application of magnesium-anode protection is very simple. Ordinarily one and one-half anodes per mile of pipe will be considerably in excess of actual requirements. During the first few months of such cathodic protection pipe to copper sulfate electrode potentials will be a good deal in excess of 1.0 volt which we expect to maintain on a well coated system. On a poor coating we feel 0.90-volt and on bare pipe 0.85-volt pipe to copper sulfate electrode is sufficient.

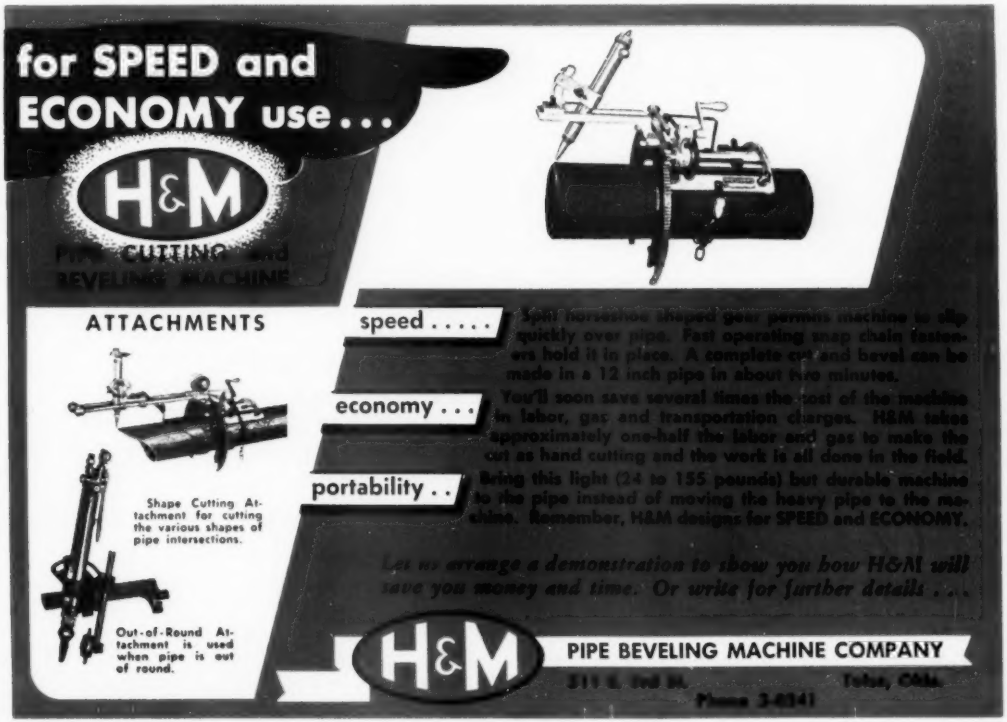
Care is taken to make meter-loop installations in a manner to prevent accidental short circuits of the meter insulation and no aluminum paint is permitted on the insulating material.

To insure continuous protection and no accidental short circuits, regulator checks are made once a month by the service department in each town by measuring across several specific insulating joints with a millivolt meter. Record and reports are made on these checks and if an appreciable loss of potential is noted, ordinarily a search will reveal accidental short circuits that will be eliminated at once.

Present practice on bare lines without cathodic protection or full protection by widely spaced cathodic units is to provide a measure of protection at the hot spots by installing magnesium anodes. Anodes are placed at leak repairs or "changeout" spots by the maintenance crews and recorded. The supplementing of widely spaced cathodic protection units with anodes will ordinarily achieve full protection through an entire section.

On bare lines it is thought to be economically reasonable to make surface potential surveys to locate corroding areas and install sufficient magnesium anodes. These anode installations are made so as to reverse side potentials a good deal more toward pipe.

Experience and the generous exchange of ideas have been responsible for great improvement in the general application of corrosion control measures. This has been developed with the cooperation of the companies interested in protection of adjacent structures affected by corrosion control practices.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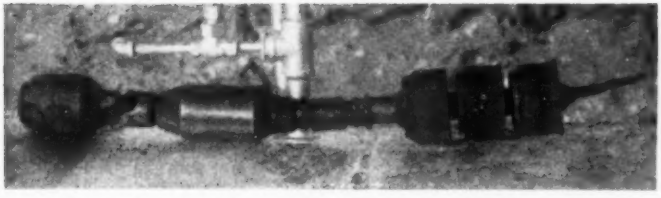
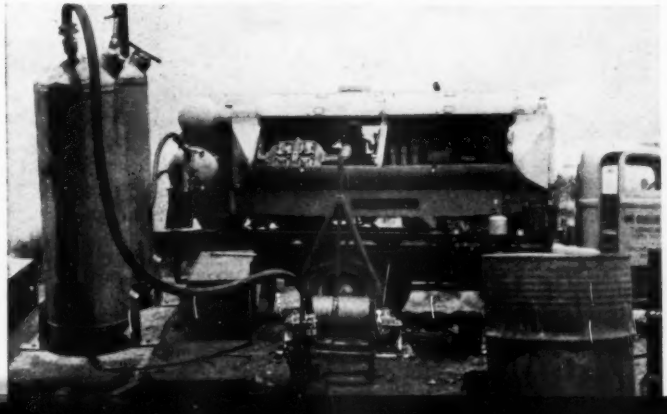
New Method of Cleaning and Coating Pipe Lines in Place

by Roy F. Carlson
West Texas District Editor



Above: The cleaning tool. Power for driving the cutting head (left) is supplied by air motor (center). Connection for a wire line is located at the right end of the tool, ahead of three sealing cups.

Below: Separator tanks which remove water from air supplied by the truck-mounted compressor (background) are shown at left in this view of the equipment. Dry air is necessary when coating is applied to the inside of the line.



INTERNAL cleaning and coating of pipe lines in place is becoming more and more widely used. The process is rapid, effective, and economical, since it reconditions and renovates old internally scaled and corroded lines without the expense of taking the line up and breaking it down joint by joint before reconditioning.

One of the methods used in West Texas by McGregor Bros. Co. is shown in accompanying pictures and described in the following paragraphs. The method has been particularly effective in gathering systems which carry the area's H.S-bearing crude oils or in salt-water-disposal lines.

The Mechanism

Heart of the cleaning method is an air-motor-driven high-speed cleaning head. This head is fitted with a set of six extremely hard toothed cutting wheels which are retractable into the body of the head. As the head rotates the cutting wheels are thrown outward against the pipe wall, and rotate upon contact with the wall. As the cutting wheels rotate their teeth chip scale from the pipe walls with a chisel-like action. The cutting wheels can be replaced with stiff-wire elements for brushing loosened material from the pipe walls.

The head is driven through a uni-

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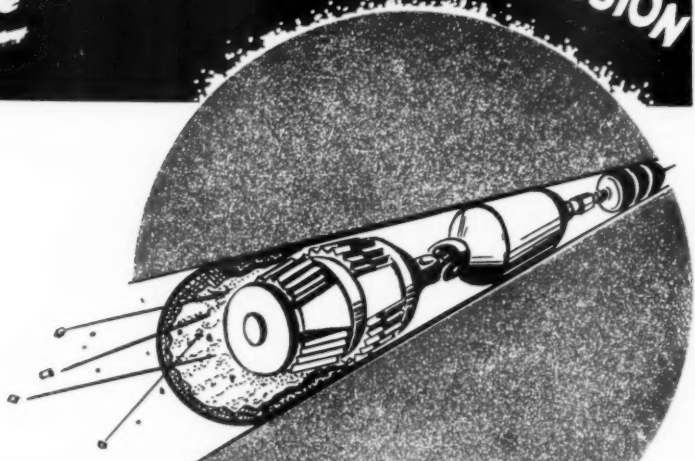
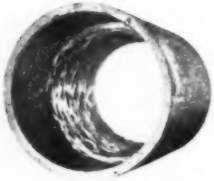


clean and coat 'in-place'



Pictured above is a section of pipe partly cleaned by the McGregor "Gopher Head"

The McGregor air-motor driven "Gopher Head" is the proven answer to reduced flow-capacity problems due to incrustation.

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versal joint by a specially designed air motor which turns at about 6,000 r.p.m. using 80-psi. air compressed at about 350 cu. ft. per minute. Air that passes through the motor flows around the head, blowing scale and dust ahead of the tool.

Air is fed to the motor through a length of tubing, around which are fitted three regular pipe-line batching cups. The cups seal off the motor from the air supply and cause all the compressed air behind the tool to flow through the motor.

A regular shooter's wire line is attached to the back of the motor assembly to control its rate of travel through the pipe. This wire line enters the pipe through a lubricator which seals the opening around the wire line. The line is contained on a reel to which is geared an air motor. Rotation of the motor permits the reel to pay off line. The rate at which the line is fed is controlled by a transmission between the motor and the reel.

Air is supplied into the pipe line behind the cleaning tool through a special sub in which the lubricator is fitted and which provides a means of introducing the tool into the pipe line. Power air is compressed in a truck-mounted portable unit, passed through a separator to remove all traces of moisture, and introduced into the pipe behind the tool. The clean pipe behind the tool acts as a reservoir for the power air.

After the scale has been removed from the walls by the air tool, used either with or without brushes, the pipe is wiped clean with burlap-sacking plugs blown through the line by application of air pressure.

Upon completion of cleaning operations a coat of primer is applied. Two plugs are used in applying this coating, with the primer placed between the plugs. The plug-primer arrangement is pushed through the line by air pressure.

Solvents are sometimes run through the line in the same manner as primer even before cleaning operations with the rotary tool are begun. The solvents are sometimes necessary for removal of heavy oil or hydrocarbon residues before cleaning.

Internal plastic coatings are applied in the same manner as the primer, between two plugs. Thermoline, a furan-type semithermosetting plastic is used by McGregor. Thinner is added to the plastic in proper proportions for correct fluidity. Sufficient thinner is added so that the plastic will be wiped onto all of the pipe wall. Too much thinner is avoided so that the coating is not too thin, or non-existent.

Drying of both plastic and primer is accomplished by passing air through the coated pipe. Air flow is caused by induction rather than pressure, to insure that the drying air is fresh, dry, and able to absorb a maximum amount of thinner from the primer or plastic. To induce the air flow, compressed air is fed into a venturi-type arrangement which causes partial vacuum in the end of the pipe thus pulling dry air into the pipe from the other end of the coated section. The section is thus dried progressively up to the end where induction is taking place.

Results of Cleaning

Scale taken from the pipe is removed in a large variety of sizes, from dust-like particles to large pieces. The gear-toothed cleaning head will also chip some metal from the walls of the pipe, but only in minor amounts since the tool is kept moving in the cleaning operations.

Electrical-resistance measurements taken on freshly cleaned sections of the pipe show an increase which might erroneously be attributed to reduction in section of the pipe wall because of removal of metal. This increase in resistance is probably due to a slight change in the crystalline character of the metal because of the peening action of the cleaning head.

The length of the line which can be cleaned in place by this method is limited only by the length of wire line available on the reel. Sections up to 5,000 ft. long have been cleaned so far in the relatively limited use of this tool.

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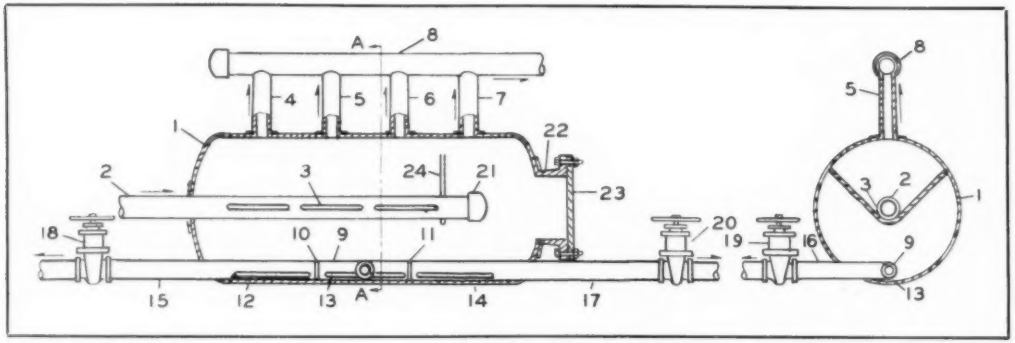


Fig. 1—Sectionalized drawing of settler. Transverse section at right represents a view of the vessel at point A-A indicated on longitudinal section, left.

How Pressure Settling Tanks Function

Effective removal of suspended materials requires consideration of densities, fluid viscosity, fineness of particles, settling rate, and tank design.

by E. A. Koenig

THE design of special settling tanks for removing suspended solids and water from petroleum pipe lines involves several factors which should be recognized clearly in order to obtain satisfactory results in operation. The settling tanks of particular concern here operate under pressure in a continuous process.

Removal of foreign matter depends upon the following: (1) Density of the pipe-line liquid; (2) density of the particles or substance to be removed; (3) viscosity of the fluid; (4) fineness of the particles removed affecting the surface so exposed and the surface tension created and their ability to stay suspended or floating; (5) the time settling rate of the matter; (6) design of the settling tank.

It is important to have in mind the relation between the density, or specific gravity of the pipe-line fluid and the density or specific gravity of the matter to be removed. The greater the difference in density, the easier it is to remove such impurities by settling. This, however, is only true for large particles. As a substance becomes fine and thin flaked, it offers a larger area in relation to its weight and may tend to float in certain liquids. In higher-viscosity crude oils, the finely divided or thin particles will tend to float. Usually, the fines are only a fraction of a per cent of such materials to be removed. Higher-viscosity liquids handled in a pipe line tend to have better lubricating properties. High viscosity, together with small amounts of fines, does not usually produce conditions which result in serious wear of pumps. However, this statement does not apply in all cases.

In lighter, less-viscous liquids, the particles may be considerably finer and still not tend to float. However, emulsions can cause dense abrasive materials to float even in gasolines.

The foregoing may be exemplified as follows: A heavy viscous (not asphaltic or tar-like) oil might hold certain particles of mill scale small enough to pass through a 10-mesh sieve. Distillate or kerosine would suspend slightly particles which would pass through 60 or 80-mesh. House-brand gasoline would only slightly suspend 160 to 200-mesh particles. These values are only approximate and depend on the stream temperature and viscosity, and the properties of the material to be removed. The settling time required depends upon the conditions stated above.

In handling light hydrocarbons such as gasolines and butanes, it becomes important to remove such suspended materials. Their removal improves pipe-line efficiencies, saves wear on machinery and, if meters are used, extends the life of such equipment. It also becomes important to remove such foreign matter under pressure easily or by a continuous method in order to prevent evaporation loss, etc.

The unit shown in Fig. 1 has been designed to utilize standard pressure vessels and fittings. Obviously, this simplifies construction and reduces both equipment and installations costs. Furthermore, salvage value is higher. By following pressure-vessel codes, this is a relatively simple piece of equipment to construct.

How Settler Works

The following itemized details of Fig. 1 with amplifying discussion on certain points will show how a settling tank functions. The various parts as indicated in Fig. 1 are:

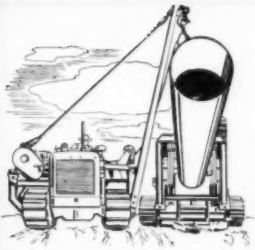
Outside tank shell, (1).

Incoming pipe line (2). This is the important part in design which depends upon the ratio of the pipe-line cross-section to the area in the horizontal section of the tank, between the pipe line and the tank shell. For example, if the tank were 48 in. i.d. by 60 in. long, the horizontal area would be 60 in. × 48 in. = 2,880 sq. in. This area, less the space of the pipe line (8-in. line; 8⅝-in. o.d.) × 54 in. = approximately 466 sq. in. Therefore, the net horizontal free area at midsection is 2,880 — 466 = 2,314 sq. in. The area of an 8-in.-i.d. pipe is approximately 50 sq. in.

$$\text{Ratio} = 50/2{,}314 = 1/46.3\ (—)$$

This will mean that upward velocity of the fluid at this point of the tank or above the pipe line is 1/46.3 of the stream into the tank. In some instances designs have been used with this ratio 1/200 or even 1/300 depending upon the requirements. In these instances 98 per cent or more of all foreign matter was removed. This result was checked by tests with the use of filters on the outlet of the tank, so as to determine the amounts remaining.

Horizontal slots (3) are located on each side of the incoming pipe line on a horizontal center of the line and tank. These slots distribute the flow



Photos shown here were made during recent laying of a 26-inch natural gas pipe line by Trojan Construction Company.

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THE AUTHOR

E. A. Koenig, general superintendent, Texas-Eastern Transmission Corp., invented and patented a settling tank or scale trap for settling under pressure of a type which has subsequently been fabricated by several petroleum pipe-line companies. He studied mechanical and chemical engineering at Texas A. & M. College and served as engineer for Magnolia Gas Co., Magnolia Petroleum Co., and Magnolia Pipe Line Co. before joining Texas-Eastern.

in a horizontal direction throughout the tank. The total area of these slots is equal to the area of the incoming pipe line. For example, an 8-in.-i.d. pipe is approximately 50 sq. in. in area.

The total area of outlet nozzles (4, 5, 6, 7) should be equal to the area of the connecting lines (1) and (8). This is in order to distribute flow.

Overhead or above tank outlet line (8) is usually connected to the pump-station suction.

Inverted siphon pipes (9, 15, 17) are divided into three or more sections by blank plates (10) and (11). These are installed in the bottom of the tank with slots (12, 13, 14) turned to the bottom.

Slots (12, 13, 14) must be equal in total area to the siphon line size (9, 15, 17).

Center section siphon line connection (16).

Siphon flow-down valves (18, 19, 20) are for removing foreign matter or scale.

Pipe cap (21) is actually a simple $\frac{1}{2}$-in. plate held by two $\frac{3}{4}$-in. bolts. This plate should have a 2-in. half-circle slot at the bottom to let large heavy particles out of the bottom end of the incoming pipe line. This plate or cap permits running scrapers into the tank.

Welding type of manhole (22) with cover (23).

Brace (24) made of $\frac{3}{4}$-in. round steel supports the incoming pipe when removing a scraper through manhole (22-23) after removing cap (21).

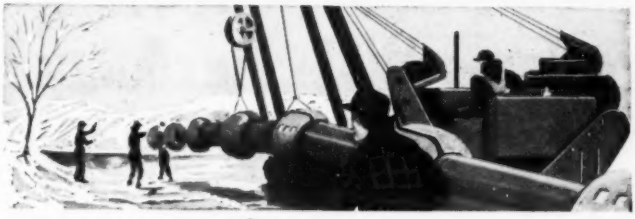
The valves (18, 19, 20) should be piped into a common manifold with a master blowoff valve to take all of the cutting action. Any of the valves (18, 19, 20) may be opened one at a time, but they should be opened wide to avoid any cutting or wire drawing. Then the master valve is opened or throttled to suit the cleaning of each siphon section (12, 13, 14). The master valve is then closed and another of the valves (18, 19, 20) opened wide and the previous valve closed. The blowdown is repeated as before to clear each section of the siphon.

For crude oils, distillate, or house-brand gasolines, a conventional 36-in.-wide by 30-in.-deep by 5-ft.-long skimmer constructed of concrete can be on top of the ground. This should have a smooth bottom except for the 4-in. drains (screw couplings flush with the bottom) and one permanent concrete baffle cast as a part of the concrete box. A sparkproof scoop or square-point shovel may be used to clean out this skimmer box as required after all usable fluid has been salvaged.

For butanes or volatile liquids a venting tank (pressure vessel) may be installed which is similar to a skimming or separator tank used in gasoline plants or refineries for separation of water from gasolines by the gravity settling method.

Where small amounts of dirt or scale are accumulated, the master blowoff line may be piped directly to a burning pit, as short quick blowoffs of 1 to 3 gal. for each section of the siphon may be sufficient. These may be drained daily at first, or weekly in accordance with requirements for cleaning the siphon sections.

From one extreme to the other



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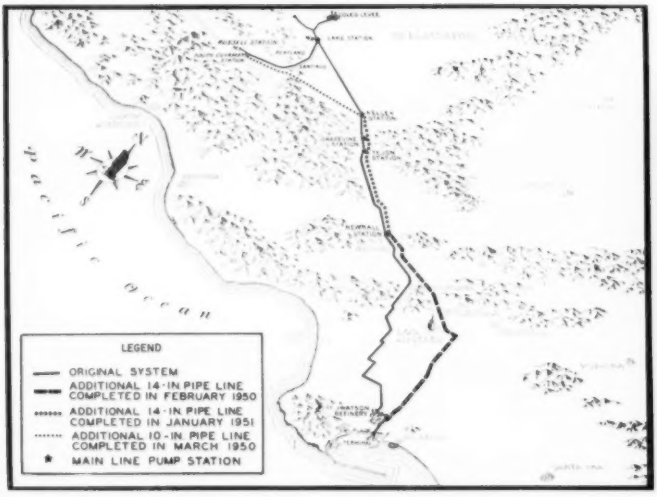

LEGEND
ORIGINAL SYSTEM
ADDITIONAL 14-IN PIPE LINE COMPLETED IN FEBRUARY 1950
ADDITIONAL 14-IN PIPE LINE COMPLETED IN JANUARY 1951
ADDITIONAL 10-IN PIPE LINE COMPLETED IN MARCH 1950
MAIN LINE PUMP STATION

Richfield Oil Corp.'s recently expanded pipe-line system which supplies crude oil to its Wilmington refinery. The system serves the Cuyama Valley and San Joaquin Valley California areas.

Alamos Creek 374-ft. suspension bridge near Caswell, Calif., on which the newest section of Richfield's 14-in. line is supported.

Richfield Pipe-Line System Features Wide Flexibility

South Cuyama discovery necessitated expansion program

by C. E. Kelley*

DEVELOPMENT of about 55,000 bbl. daily of new crude-oil production in Cuyama Valley fields of California during the past 3 years has caused Richfield Oil Corp. to invest around $8,300,000 in expanding the northern pipe-line system serving its large Wilmington refinery.

Prior to the discovery of Cuyama's first oil field, Russell Ranch, in June 1948, the system was transporting about 26,000 bbl. daily from San Joaquin Valley fields. It was composed principally of a collecting system in Midway-Sunset field, a main gathering line from Coles Levee to Buena Vista Lake station, and a 10-in. main line from this station to Wilmington.

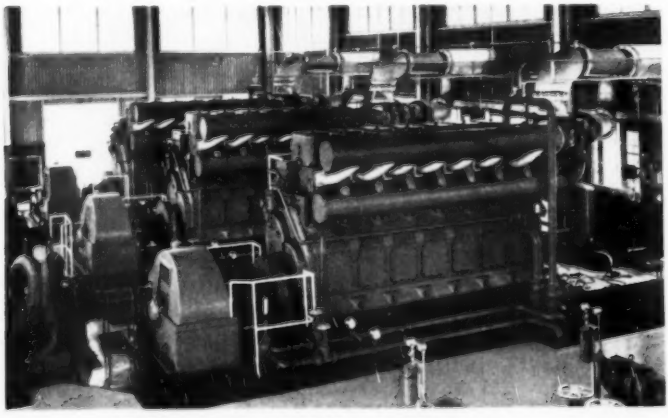
First permanent outlet for Russell Ranch was provided in April 1949 by an 8-in. line from that field to Richfield's Santiago lease near Maricopa, where the crude joined shipments from San Joaquin fields. With the discovery of South Cuyama a month later it soon became apparent that additional facilities would be necessary.

First step in carrying out the expansion program was the installation of an already designed 14-in. 58-mile line from Newhall to the refinery. This line was deviated from the existing 10-in. crude carrier so that it would traverse flat terrain and could serve storage facilities at Vinvale and Hynes. This section, completed in February 1950, increased the capacity of the system from 33,000 to over 40,000 bbl. per day without installation of additional pumping equipment.

Second step in carrying out the master plan was the construction of a 40-mile, $10\frac{3}{4}$-in. line from the South Cuyama pump station to the Kelley station at Wheeler Ridge. Completed in March of last year, it was designed for a minimum capacity of 51,000 bbl. daily. Since the 8-in. line to Santiago has a calculated capacity of 28,000 bbl. daily, both lines provide ample capacity for all oil being produced in Cuyama Valley fields.

Final step was the construction of the link between Wheeler Ridge and Newhall and the addition of two new,

*Executive assistant, manufacturing department, Richfield Oil Corp., Los Angeles.



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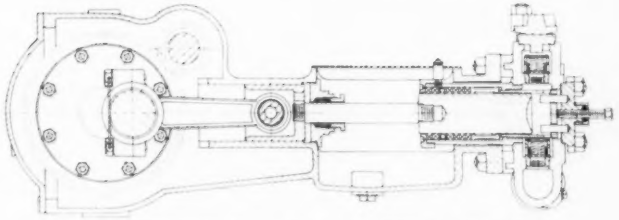

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modern pump stations at Wheeler Ridge and Tejon. This 54-mile section of 14-in. line was completed last January.

Careful consideration was given to selection of line-pipe size and location, and pump-station size and location. Fundamental consideration, of course, was the capacity to transport a minimum of 75,000 bbl. per day of crude oil from the southern portion of San Joaquin Valley to the Wilmington area. Economy in operating manpower indicated the desirability of locating the new pump station on or adjacent to the existing Los Angeles-Midway line pump stations.

Investigations disclosed that the substitution of about 14 miles of 16-in. pipe in place of the normal 14-in. at a selected location would eliminate the need for a third pump station, would not reduce the previously determined line capacity, and would permit the installation of the second station at the site of the existing Tejon station. In addition, the substitution of the 16-in. pipe could be made at an estimated cost of substantially less than one-half of the cost of the station to be eliminated, and the future operating cost of one station dispensed with.

This plan was incorporated in the system's design so that last station on the new 14-in. line is at Tejon, 112 miles from the line's terminus. Features of this station, and of the new Kelley station at Wheeler Ridge, will be discussed later.

Upon completion of the final weld in the Wheeler Ridge - to - Newhall line, a pipe-line scraper of conventional design was introduced and forced through the pipe. As a precautionary measure, a radium capsule was attached to the scraper and its progress was checked by Geiger counter at points along the route. Had the scraper become lodged in the line, a Geiger counter could have located the position, thus indicating the spot from which to recover the scraper and eliminate the cause of stoppage. However, the scraper passed through the line without difficulty.

What is believed to be a novel procedure was utilized in connection with pushing the scraper through the 16-in. pipe between Wheeler Ridge and Tejon stations. The water supply for Wheeler Ridge station is adequate only for normal operating conditions and the domestic requirements of the operating personnel. There is, however, an ample supply of water at Tejon station for testing and scraper operation. As it is easier to pump water and a scraper down hill, the novelty lay in the fact that the scraper traveled north from Tejon to Wheeler Ridge on the assumption that if it would go north it would also go south, the direction in which the crude oil was to flow.

Station Design

Flexible operation of the new pumping facilities at Wheeler Ridge and Tejon is attained through proper operation of the station manifolding and storage tanks. At each station there are two 37,500-bbl. crude tanks, and at Wheeler Ridge an additional 54,000-bbl. tank was installed. These tanks can receive crude oil while the stations are pumping or can float on the line.

The manifold is capable of performing many flow combinations. At Wheeler Ridge the manifold is capable of operating as follows:

1. Receiving crude oil simultaneously from the 10-in. Cuyama line and the 10-in. Los Angeles-Midway line, and delivering the combined streams to the 20-in. suction header connected to the main line pumps.

2. Receiving crude oil into the 20-in. suction header from the 10-in. Cuyama line and any one of the three storage tanks, while the flow of crude oil from the 10-in. Los Angeles-Midway line is entering either tank not flowing to the 20-in. suction header.

3. Identical with No. 2 except for interchanging the flow of the two 10-in. lines which deliver crude oil to Wheeler Ridge.

Operation of the old Wheeler Ridge station (for the 10-in. Los Angeles-Midway line) is in no way affected by the operation of the new station. The old and new stations are capable of operating simultaneously.

At the Tejon station, the manifold is capable of performing as follows:

1. Receiving the entire Wheeler Ridge discharge stream and delivering it directly into the 20-in. suction header.

2. Identical with No. 1 except that one or both tanks may be open to the 20-in. suction line to receive excess or make up deficit volumes as desired.

3. Receiving the entire Wheeler Ridge stream into one tank while withdrawing oil from the other tank for pumping.

From the manifold the crude oil flows through the new pump stations in the following sequence: Entering the 20-in. suction header the stream

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is divided and flows through two strainers, converging again to a single stream. A portion of the single stream is then bypassed through three heat exchangers and, reconverging, is delivered by the 20-in. suction header to the main line pumps, at 25 psi. for optimum operation.

The main-line centrifugal pumps boost the pressure in six stages and discharge the crude oil at approximately 1,550 bbl. per hour each into the 16-in. discharge header. In the discharge header an orifice is fitted from which the discharge pressure and rate of flow are transmitted to the control panel located in the station office. Downstream from the orifice at Wheeler Ridge the 16-in. discharge header becomes the 16-in. line from Wheeler Ridge to Tejon; at Tejon the 16-in. discharge header is swaged down to 14-in. line from Tejon to Newhall.

A connection from the 16-in. line between Wheeler Ridge and Tejon to crude-storage tanks at Grapevine station (on the 10-in. Los Angeles-Midway line) was made to allow Wheeler station pumpings into Grapevine storage or to drain the 16-in. line back from Tejon. Oil from Grapevine storage cannot be returned to the 16-in. line through this connection, but will be pumped through the 10-in. line to storage at Tejon for delivery into the 14-in. line at that location.

The three basic pumping units located at each of the new stations are manifolded to operate in parallel. Two units are required to operate at any given time to handle the designed volumes, with the third unit serving as a standby.

The pumps are Byron Jackson 6 by 8, six-stage, heavy-duty pipe-line-type centrifugal units. The prime movers are Nordberg four-cycle, seven-cylinder, mechanical injection, 1,050 hp. at 450 r.p.m. Duafuel full diesel engines. The speed increasers are Western Gear Works 450-3,600-r.p.m. continuous-service gear units.

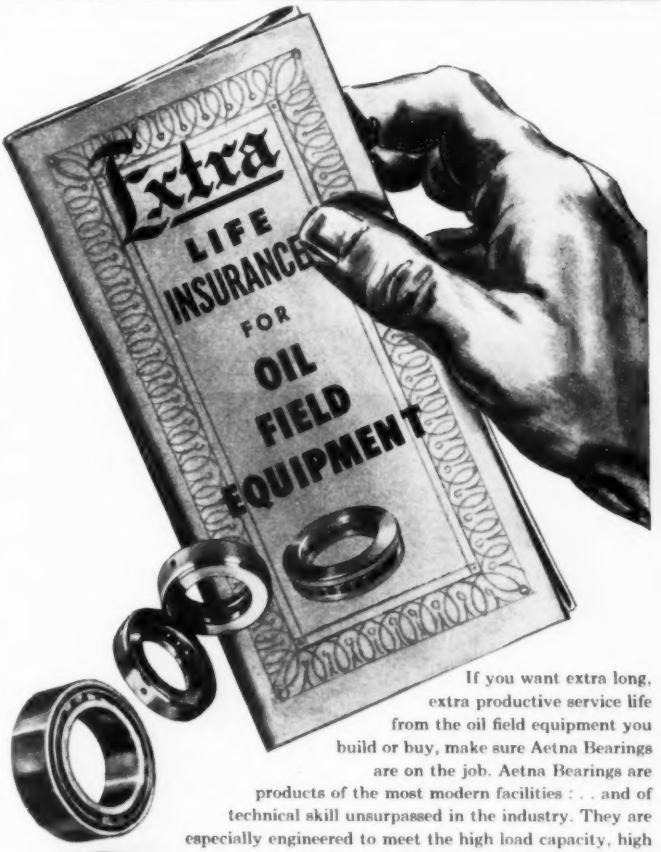
The Duafuel engines, as installed at Richfield's new pump stations, and the straight diesel engine are basically the same design. The only difference lies in the addition of connections and regulating mechanisms to allow the engine to operate on crude oil, or on gas with crude oil as pilot fuel. The engine is always started on diesel fuel oil then changed to crude oil. At Wheeler Ridge and Tejon the engines will operate on 100 per cent crude oil taken from the pipe-line stream or on 90 per cent natural gas with 10 per cent crude oil as pilot fuel.

Crude to be used as fuel oil is purified by passing through a Sharples centrifuge operating at approximately 15,000 r.p.m. The centrifuge effectively removes whatever impurities might pass the pipe-line strainers and the clean crude oil is stored in two 3,000-gal storage tanks at each station.

At Tejon station, an automatic engine-speed regulator controls speed of the engines by pressure of the crude oil in the pipe line, thereby synchronizing pumping at Tejon with pumping at Wheeler Ridge.

In the offices at Wheeler Ridge and Tejon are Westinghouse special control panels containing Bristol remote-control recorders and indicators for suction header pressure, individual pump discharge pressure, and discharge-header flow and pressure. These instruments are actuated pneumatically. Crude-oil temperature and engine speed indicators are electrically actuated.

The station operator makes hourly reports over Richfield's private telephone line to the pipe-line dispatcher in Long Beach. Through this private line the dispatcher coordinates the operation of Richfield's entire 714-mile pipe-line system. An additional installation which assists the dispatcher consists of orifice-meter fittings which are installed at the Newhall station and at the Watson refinery. Bristol telemetering equipment has been ordered and will be installed which will measure, transmit, and continuously record in the dispatcher's office in Long Beach the instantaneous flow rates at these points.



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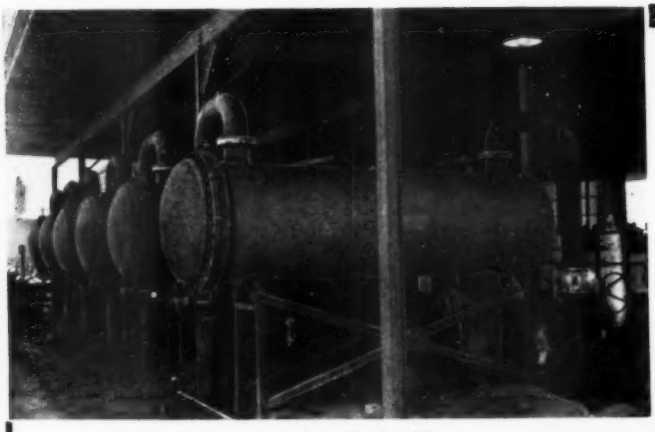

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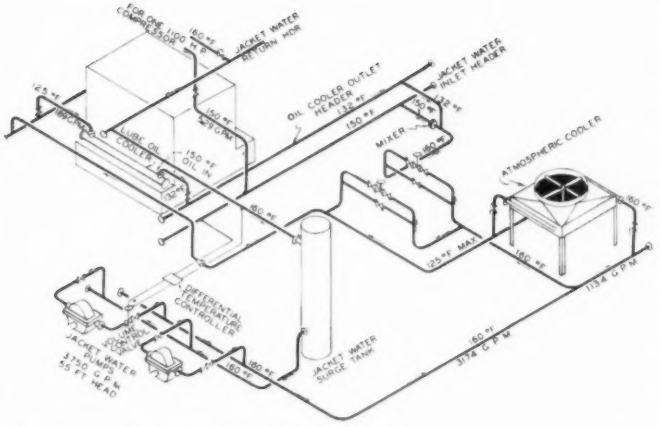

Fig. 1—Schematic arrangement of compressor cooling-water system serving six 1,100-hp. units. For simplicity only one compressor unit is incorporated into the diagram. Calculated values are given for 6,600-hp. requirements.

Atmospheric Water Coolers

. . . applied to gas transmission

T.G.T. takes a look at its policy of economy in the use of water, after 5 years of operation. Presented here is a discussion of advances in cooling practices

by E. S. Murray

PRESENT drought conditions with the attendant receding water table, coupled with rising costs of all equipment used in generating electricity and pumping water has magnified the problem of acquisition and handling of water into one of major importance in all main-line gas-transmission systems.

Tennessee Gas Transmission Co. has been forced to depend on surface water supplied by nearby streams or artificial lakes and reservoirs at all the stations north of Central Tennessee. These installations are expensive to build and operate, thus placing a well-defined value upon the water obtained from these sources.

With this in mind, all of the stations built since 1947 have been designed primarily to conserve water and the electrical energy required to pump it, since this is a continuous expense item.

During the past two drought years along the south portion of the line, the policy of economy in the use of water has paid off by minimizing the demands made on the drilled wells in areas of receding water tables. Thus, the stations along the entire line have had reason to benefit by the conservation policy inaugurated while the system was being built. This is a fortunate situation not readily obtainable in older transmission systems where lack of water is just as serious.

Experience encountered in the actual operation of one engine room of 10 000 rated horsepower furnishes specific operating data after approximately 5 years of operation. The station is in the approximate center of the system.

Nine Radiator Sections

This station is equipped with nine radiator sections of standard make using one 15-hp. fan per section, with two fans having two-speed motors as a means of closer control during wide-range atmospheric variations.

There is 97,200 sq. ft. of cooling surface in the form of copper core-type radiators similar to that used on truck or diesel-locomotive engines. The engine-jacket cooling system is designed to use only one circuit for both oil coolers and jacket water cooling through the engines.

One centrifugal unit, driven by a 60-hp. 1,200 r.p.m. motor, pumps all of the water required to cool the ten 1,000-hp. units in this building. Thus the maximum connected electrical load for engine cooling is 135 hp. for the radiator fans plus 60 hp. for the circulating pump. This load evaluation is deceptive in that it does not require all of the connected load to be in continuous service.

On a typical summer day with atmospheric temperature at 95° F. and full load on the engines the electrical energy required to pump the cooling water varied approximately with the temperature of the atmosphere.

From 11 a.m. to 3 p.m., while the air was 94° to 96° F., there were eight 15-hp. fans and one 60-hp. motor in operation, approximately 180 actual horsepower per hour for 4 hours.

From 3 p.m. until sundown one fan and then another were shut down as the temperature of the air varied. As the yard-lighting load came on, the fan requirements decreased until there was only slight variation in electrical demand, resulting in a smooth load curve on the generator units.

During the night from 9-10 p.m. until 6 a.m., approximately 8 hours, five fans were in service resulting in total electrical load of 135 hp. for one-third of the calendar day in midsummer.

During the winter months this plant is cooled by 90 to 120 hp. over long periods of time.

Makeup Water Requirement

In addition to the above economy in electrical energy, there is no makeup water required except for slight leakage at pump glands and evaporation at surge tank.

The above arrangement proved to have considerable merit and since 1947 all of the new stations, totaling approximately 200,000 compressor horsepower, have been designed to use some form of atmospheric cooling and single circuit for jacket-water cooling.

Presently there are three general classifications of cooling sections now in service in this system.

1. Horizontal radiator core-type sections usually 2 ft. wide and 6 or 8 ft. long with a 15-hp. motor using a V-belt drive for the fan which is set above the radiators.

2. Header-type sections using 1-in. diameter brass tubes with either aluminum or copper fins. Tubes are usually 20 ft. long set horizontal with two small 7½ or 5-hp. fans per section.

3. Header-type sections arranged as in item (1) but having ⅝-in. diameter round or oblong tubes.

The same cooling circuit is used in each case and similar economies in water consumption are obtained regardless of type of cooling surface.

Fig. 1 indicates diagramatically, an actual installation, and shows calculated results for six engines or a total of 6,600 hp.

(Continued on page 310)

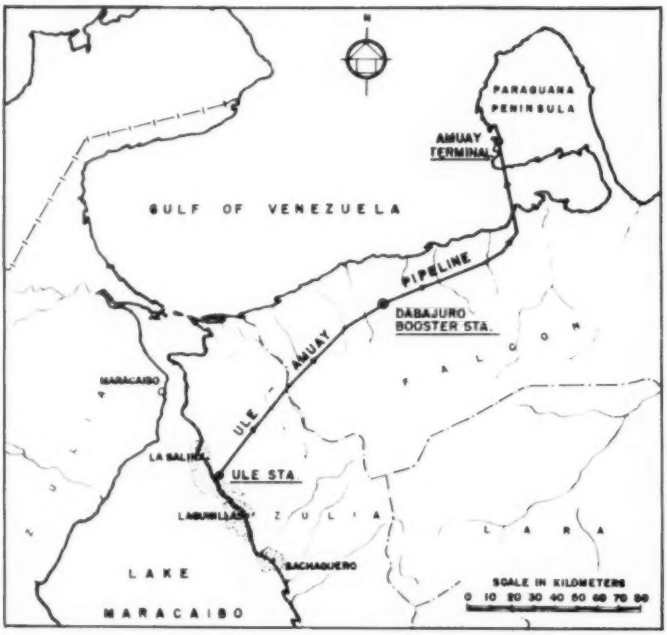

Fig. 1—Route of Creole pipe line from Ule station to Amuay Bay terminal in Venezuela.

FRICTION LOSSES—

in large-diameter crude-oil pipe lines

by W. P. Redmond

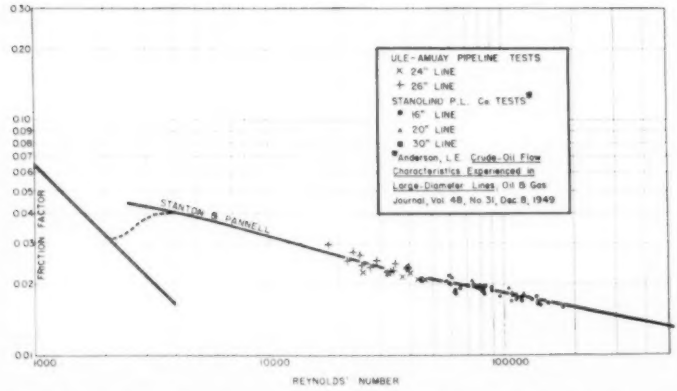

Fig. 2—Results of friction-factor tests. Data plotted in relation to Stanton-Pannell curve.

All friction-loss calculations for pipe lines are based on experimental data derived from tests made on small lines. Question often is asked, "Is this information accurate enough for use in the design of large lines?" A number of tests were made by Creole Petroleum Corp. on the 24 and 26-in. sections of the Ule-Amuay pipe line in Venezuela to verify this. Also some tests made by Stanolind (Service) Pipe Line Co. were taken from the literature for comparison. The friction factors obtained in all these tests were found to be in good agreement with the Stanton and Pannell curve which has long been used as the basis for friction calculations.

IT is only during recent years that the development of higher-strength steels and improved construction techniques have made possible the laying of large-diameter pipe lines. The term "large diameter" lines is a relative one, but among pipe liners is usually understood to mean lines of 16-in. outside diameter or larger. The advent of larger-diameter lines has stimulated the use of technical data rather than the old rule-of-thumb methods. Initial investment costs are so high that it is necessary to predict accurately the capacities of these lines. At such high pumping rates a small error in calculation can mean a large difference in initial investment.

Pipe-line hydraulics.—The D'Arcy equation for fluid flow in circular pipes is still the basis of all pipeline calculations today. All of the terms in this equation are known or can be measured except the friction factor, f. It was discovered that for streamline flow the value of f is indirectly proportional to the Reynolds number. However, for turbulent flow the value of f is dependent upon both Reynolds number and the roughness of the pipe wall. Values of f are used which have been determined experimentally. By plotting values of f against Reynolds number, a smooth curve results for all pipes of the same degree of roughness, regardless of pipe size or fluid characteristics. Accordingly, then, different curves are required for different kinds of pipe; one curve for glass tubing, another for brass pipe, still another for concrete pipe, etc. For steel pipes one curve has been found accurate enough. Over a period of years data collected on pipe line tests have been found to fall along this curve. In general the curves which are now used are based on experiments performed on pipes of 12-in. diameter and smaller. Much of the experimental work was done in England about 1914 by Stanton and Pannell at the National Physical Laboratory. In order to determine pressure losses for any installation it is first necessary to calculate the Reynolds number; after which the corresponding value of f is found on the Stanton and Pannell curve. This f value is sub-

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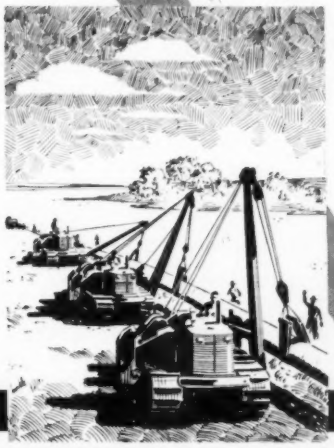

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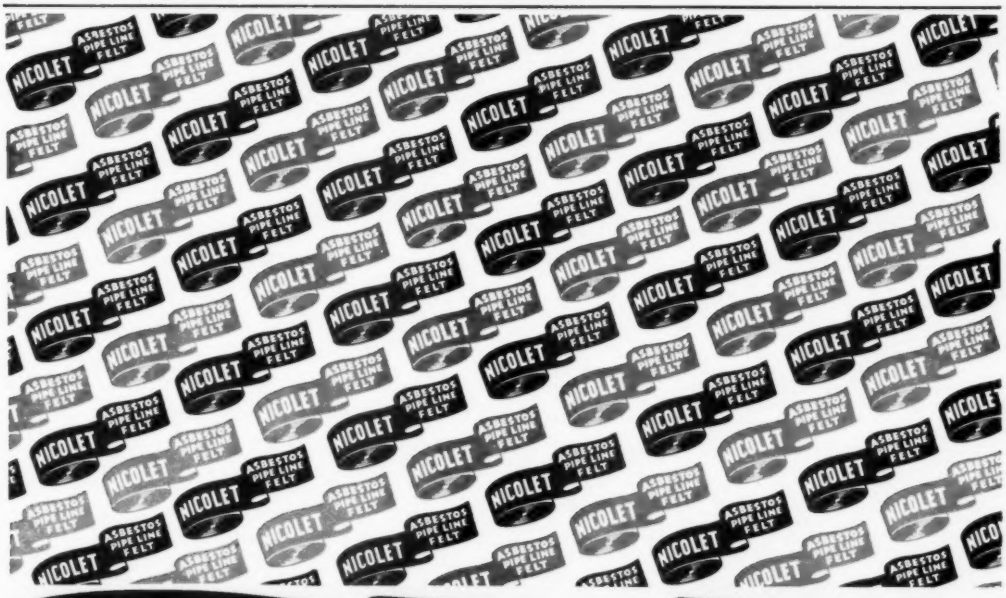

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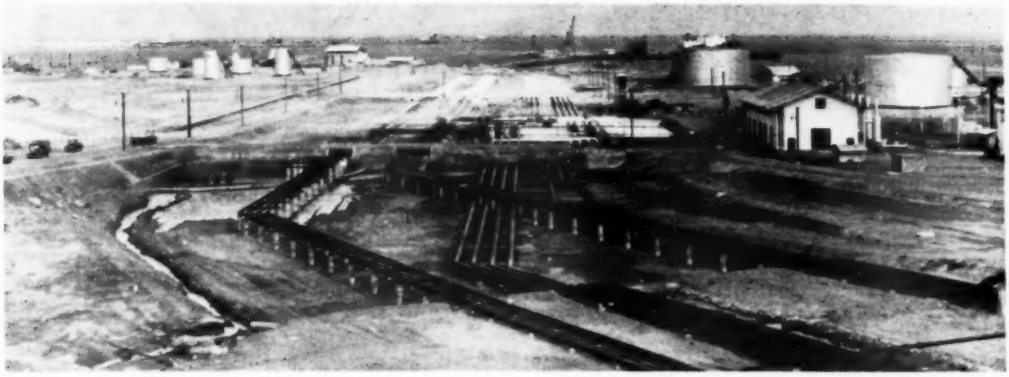

Fig. 3—Crude and products loading lines at Creole's Ule-Amuay pipe-line terminal in Amuay Bay. At right is crude-oil pump station to unload tankers.

stituted in the D'Arcy equation along with the known values of the other terms to yield an answer for h_f, the fluid head loss due to friction.

Since many large-diameter lines are being designed today, the question has arisen as to the validity of empirical data which were derived on smaller lines. Does the Stanton and Pannell curve hold for large lines as well as small ones? Theoretically the curve should hold for any size line as long as the relative roughness of the lines remains approximately the same.

When Creole began operations on the Ule-Amuay pipe line in 1948, this gave an excellent opportunity to check the Stanton and Pannell curve for pipe sizes of 24 and 26-in. Accordingly, a project was begun in the latter part of 1949 to measure the friction losses in both the 24 and 26-in. sections of this line.

The Ule-Amuay pipe line.—The map, Fig. 1, shows the route of the Ule-Amuay pipe line. It transports about 300,000 bbl. per day of medium crude from Ule to Lake Maracaibo to the Amuay Bay refinery and tanker terminal on the Paraguana Peninsula. The line, through which the crude is pumped in two stages, has a total length of 142.5 miles. In addition to the Ule station there is another and identical station at Dabajuro, the approximate midpoint. Each station contains seven 8 by 24 horizontal double-acting triplex Worthington pumps driven by Cooper-Bessemer 1,000-hp. LS-8 dual-fuel engines. The capacity of each pump is about 50,000 bbl. per day. The first 11 miles out of Ule and for 15 miles out of Dabajuro the line is 24-in. pipe (23.125-in. o.d.). The remaining sections are 26-in. pipe (25.250-in. i.d.). At a point about 52.5 miles from Dabajuro the line enters the Gulf of Coro where there is a 15-mile underwater crossing. The 26-in. line in the crossing has a slightly thicker wall, being 25.000-in. i.d.

TABLE 1—ULE-AMUAY PIPE LINE—FRICTION FACTOR TESTS

26-IN. PIPE—NORTH SIDE OF WATER CROSSING TO AMUAY SCRAPER TRAP

Test	P_1 (psi.)	P_2 (psi.)	B.D.	T_1 (°F.)	T_2 (°F.)	A.P.I.	Viscosity S.S.U.*	Re	f
1	159.4	25.4	305,013	82.0	89.6	28.8	155.3	33,376	0.0224
2	152.0	27.5	289,194	83.0	91.3	28.8	153.0	32,498	0.0225
3	126.4	26.5	241,616	84.0	91.4	28.6	151.8	27,374	0.0234
4	107.8	17.9	220,782	84.6	95.6	28.8	145.6	26,166	0.0239
5	96.8	17.7	194,656	84.1	88.8	28.4	152.6	21,929	0.0250

Length of line is 9.322 miles—Test Point 2 is 85.675 ft. higher in elevation than Point 1

*This represents the viscosity at average temperature between the two test points

24-IN. PIPE—ULE STATION TO MAIN LINE SCRAPER TRAP NO. 1

Test	P_1 (psi.)	P_2 (psi.)	B.D.	T_1 (°F.)	T_2 (°F.)	A.P.I.	Viscosity S.S.U.*	Re	f
1	875	596	297,316	84	84	29.7	129.0	43,914	0.0209
2	665	427	254,376	84	85	29.7	128.0	37,572	0.0214
3	440	236	174,528	84	88	29.4	124.0	26,932	0.0327
4	313	131	122,688	84	91	29.4	121.0	19,457	0.0496

Length of line is 10.984 miles—Test Point 2 is 305.0 ft. higher than Point 1

26-IN PIPE—MAIN LINE SCRAPER TRAP NO. 1 TO DABAJURO STATION

Test	P_1 (psi.)	P_2 (psi.)	B.D.	T_1 (°F.)	T_2 (°F.)	A.P.I.	Viscosity S.S.U.*	Re	f
1	596	18	297,316	84	81	29.7	131.0	39,542	0.0233
2	427	17	254,376	85	83	29.7	129.0	34,409	0.0228
3	236	16	174,528	88	84	29.4	124.0	24,665	0.0265
4	131	15	122,688	91	86	29.4	119.0	18,155	0.0293

Length of line is 55.005 miles—Test Point 2 is 26.2 ft. lower than Point 1

24-IN. PIPE—ULE STATION TO SCRAPER TRAP NO. 1

Test	P_1 (psi.)	P_2 (psi.)	B.D.	T_1 (°F.)	T_2 (°F.)	A.P.I.	Viscosity S.S.U.*	Re	f
1	885	600	301,330	92	89	28.7	125	46,100	0.0208
2	705	457	257,400	92	92	28.8	124	39,700	0.0224
3	505	304	207,200	92	93	29.0	123	32,300	0.0223
4	365	196	160,300	92	94	29.0	121	25,400	0.0224

Length of line is 10.984 miles—Test Point 2 is 305.0 ft. higher than Point 1

26-IN. SCRAPER TRAP NO. 1 TO DABAJURO STATION

Test	P_1 (psi.)	P_2 (psi.)	B.D.	T_1 (°F.)	T_2 (°F.)	A.P.I.	Viscosity S.S.U.*	Re	f
1	600	8	301,330	89	85	28.9	134	39,100	0.0232
2	457	7	257,400	92	88	28.9	128	35,100	0.0243
3	304	7	207,200	93	89	28.9	125	29,100	0.0251
4	196	6	160,300	94	91	28.9	122	23,100	0.0272

Length of line is 55.005 miles—Test Point 2 is 26.2 ft. lower than Point 1

THE AUTHOR

W. P. Redmond is with Creole Petroleum Corp., Caracas, Venezuela, as research engineer in the pipe-line section of the production department. He graduated from Rice Institute in 1941 with the B.S. degree in chemical engineering.

With the exception of a few places where it dips under roadways, the pipe is laid directly on the ground. All river crossings are above water, the pipe being supported on bents or bridges. The terrain is fairly level on the whole, but passes through some low rolling hills. The highest point, which lies between Dabajuro and the Gulf of Coro, is at an elevation of 457 ft. above sea level. The right-of-way passes through dense swampy jungle, semiarid, and finally extremely dry, sandy desert.

Creole friction tests. — The D'Arcy equation is somewhat unhandy to use because some of the terms in it are not commonly used in pipe-line work. For the sake of convenience, then, the D'Arcy equation was converted to the following:

$$P = \frac{3.444 \times 10^{-6} \, f \, Q^2}{d^5 \, (131.5 + {}^\circ\text{A.P.I.})} \qquad (1)$$

where

P = pressure loss in psi. per mile
f = friction factor
Q = flow rate, barrels per day
d = pipe diameter (i.d.) in ft.
°A.P.I. = fluid gravity, A.P.I. basis

A similar conversion was made on the Reynolds number equation, so that:

$$Re = 8.274 \times 10^{-5} \frac{Q}{d} \frac{\rho}{\mu} \qquad (2)$$

where

Re = Reynolds number
ρ = fluid density in lb. per cu. ft.
μ = viscosity in lb. per ft.-sec.

The first series of tests were made on the last 9.32 miles of the line between the north side of the Gulf of Coro and the scraper trap at the Amuay tank farm. At this time five separate tests were made at different rates of flow, each test lasting 2 hours. Throughout each test pressures and temperatures were read every 15 minutes. Also the tank into which the lines were discharging was gaged every 15 minutes in order to establish the rate of flow. The Dabajuro station held the flow fairly steady by watching its flow meter. During each test samples were taken at both ends of the test section at 15-minute intervals. These samples were later tested in the laboratory for viscosity and gravity.

Two more series of tests were run later on the whole section of the line between Ule and Dabajuro. Here it was possible to test the 25 and 26-in. sections simultaneously. Pressures and temperatures were measured at the Ule station, the scraper trap where the 24-in. line changes to 26-in., and at the Dabajuro station where the stream discharges into tankage. Crude samples were taken at Ule for viscosity and gravity determinations.

At the beginning of the tests the Ule station was pumping Tia Juana medium crude at about 300,000 bbl. per day with six units operating. At 10-minute intervals temperatures and

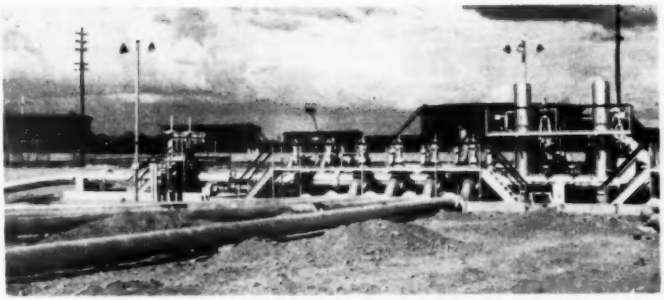

Fig. 4—View of storage tanks and manifold at Ule.

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pressures were measured at the three test points. Also the tank which was being run was gaged at 10-minute intervals to determine the flow rate. At the end of 30 minutes one unit was shut down, reducing the rate of flow by about 50,000 bbl. per day. The readings were continued and at the end of another 30 minutes another unit was shut down. This was repeated once again so that in all four separate tests were made at different rates of flow. Using the data collected in this manner, the friction factor and the Reynolds number for each test was calculated for the two equations above.

The results of the calculations are given in Table 1 and are shown graphically in Fig. 2. The Stanton and Pannell curve for steel pipe has been drawn in Fig. 2 for comparison with the test results. As a further check some data taken by Stanolind have been plotted in Fig. 2. This information was taken from an article by Lowell E. Anderson entitled "Crude-Oil Flow Characteristics Experienced in Large-Diameter Lines," *(in the December 8, 1949, issue of The Oil and Gas Journal).* The Stanolind data were taken on 16 and 20-in. lines, but there are also three points from tests on 30-in. line.

Results.—In Fig. 2 the Stanton and Pannell curve appears to represent a very good average of the experimental points. The data of both Creole and Stanolind are fairly well scattered on both sides of the curve. All three of the tests made on 30-in. pipe fall above the curve, but for all other sizes there are points both above and below the curve. According to the theory, the friction factor is dependent on the relative roughness of the pipe. Relative roughness means the ratio between the profile of the wall and the pipe diameter.

If the profile of the wall remains about the same, the relative roughness would decrease with increasing pipe size. Therefore, we would expect lower friction factors for larger pipe sizes. The results do not support this idea. Since the steel pipe is fairly smooth, it may be that the change in relative roughness is not great enough to affect the friction factor. It may be possible also that the experimental error involved is large enough to obscure such evidence. At any rate, if such a correlation between relative roughness and pipe diameter exists, it is not of practical importance if it cannot be detected in normal operation.

Atmospheric Water Coolers

(Continued from page 305)

It should be noted that only about one-third of the total water is pumped through the cooling sections; the remainder is not cooled, being merely mixed with the water cooled only for the oil coolers. This permits a workable mean-temperature difference across both the water cooling sections and the oil coolers with a minimum of pressure drop.

The oil cooler is sized to fit the heat load in the oil and for the water available from the water coolers, all determinations are based

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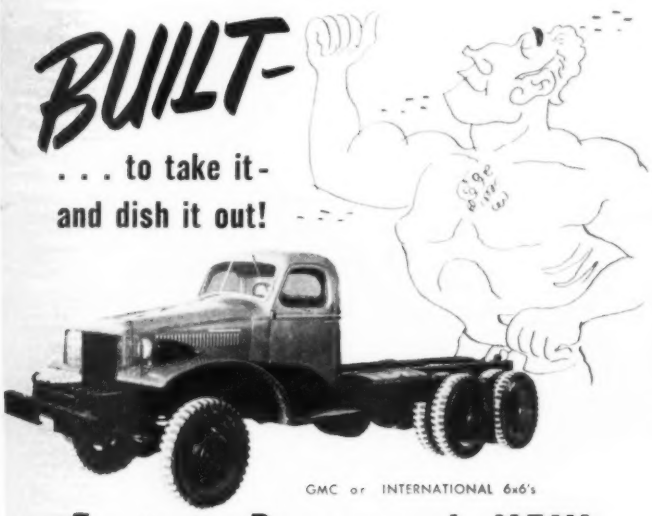

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THE AUTHOR

E. S. Murray, assistant chief engineer, Tennessee Gas Transmission Co., has been engaged in pipe-line and compressor station engineering for the company since November 27, 1943. Following graduation from Colorado A. & M. College in mechanical engineering he was field artillery officer in World War I. His oil and gas industry experience in construction, operation, and design includes: 9 years, Midwest Refining Co., natural-gasoline plants, Wyoming; a year with Marland and Pure Oil Companies, Oklahoma; 9 years, International Petroleum Co., Ltd., and Tropical Oil Co., South America; 4 years, Northern Natural Gas Co. and Natural Gas Pipeline Co. of America; and 2 years, J. F. Pritchard Co., Kansas City.

on atmospheric temperatures of 100° F.

A differential-type volume controller is mounted on the circulating pump discharge to maintain the desired difference between jacket-water inlet and outlet temperatures. With the volume under automatic control, a simple butterfly valve operated by a temperature controller on the jacket water inlet header permits passage of enough uncooled water to a mixer on the outlet of the oil-cooling outlet header to maintain the desired inlet temperature.

Temperature equilibrium is maintained throughout variable atmospheric conditions by manual manipulation of fans throughout a given day or by shutting down and draining complete radiator sections as cold weather approaches. Aerial coolers are very efficient without fans when atmospheric temperatures remain below 50° F. particularly with deep cowling around the fan to give stack action to the rising current of air heated by the water in the radiator section.

From actual installations on this system, from Texas to West Virginia on one line and Massachusetts state line on the other line, the following data will apply.

1. Aerial cooling surface requirements vary from 9.4 sq. ft. per horsepower at the north end of the lines to 11.2 sq. ft. at the south end of the system.

2. The type of surface, i.e., tubular, "ob-round," or radiators, does not materially change the amount of surface required.

3. All types of engines presently used in the main-line gas transmission can be cooled economically in any location or system.

4. The original costs of these aerial-type coolers vary almost directly with the weight of nonferrous metals used in their construction.

Some manufacturers are more favorably located with regard to freight rates, nearness to raw materials, etc., but there is very little difference between manufacturer's prices in large orders covering the entire line.

5. Electrical energy required varies inversely with square feet of cooling surface throughout a wide range of combinations.

6. Automatic controls should always be workable under all conditions and they should be kept to a minimum.

7. Water losses either from leakage or evaporation can be minimized by using any type of aerial cooler.

8. Maintenance is low and in most cases negligible if the water is free from scale and properly dosed with one of the chromate salts. Any water that has been properly treated for the engine jackets will work well in the aerial cooling system.

9. A single circuit for engine cooling, using one pump and properly sized oil coolers and water-cooling sections, can be designed so as to require only a minimum of electrical energy and negligible amounts of makeup water.

An engine-cooling system requiring electrical energy not in excess of 2 per cent of the total installed compressor horsepower can be designed to operate successfully in all climates encountered in this system from New York to Texas.

10. The experience of Tennessee Gas Transmission Co. is comprehensive to the extent that it includes the use of various types of aerial coolers on over 200,000 hp. of four different manufacturers in 10 different sizes in 8 states along the system.

11. On the north end of the system where gas cooling is not needed and where aerial coolers are used on the engine circuit, the largest demand for water comes from employes' residences, usually under 400 gal. per day per family.

BOOKS

REPORT OF INVESTIGATIONS NO. 8 (PETROLEUM AND NATURAL GAS SERIES NO. 1), by Robert L. Alkire. Published by the Ohio Division of Geological Survey, Columbus.

The Petroleum and Natural Gas Series of the Division of Geological Survey makes its first appearance with this issue, which is divided into two parts. Part 1 reviews the current annual drilling activity in the State of Ohio, and Part 2 presents new material and reproduces some of the old material—past history of oil operations in the state. The book brings out some of the colorful work in pioneer drilling operations in the Marietta vicinity. Numerous tables, charts, and diagrams are also presented.

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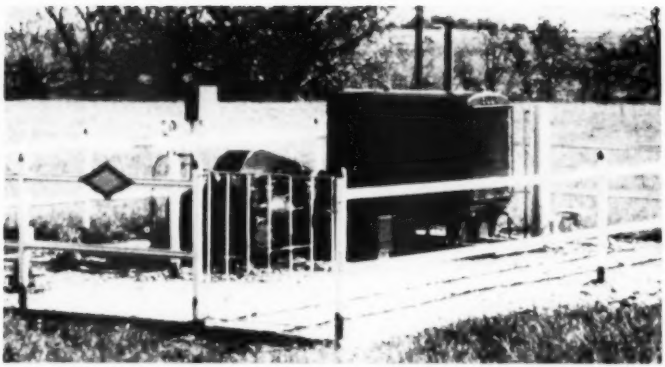

Typical Mid-Continent Petroleum Corp. field pumping unit, with 42-hp. engine drive.

Improved Methods for Crude-Oil Gathering-Line Service

by Alva C. Smith

Substantial economies have been accomplished through improvement of pump and engine practices in connection with gathering-line operations. This article deals with a few of these methods developed by Mid-Continent Pipe Line Co.'s organization which have contributed to the reduction of gathering-line costs in spite of an upward trend which has been generally characteristic of industry costs in recent years.

DURING the past 5 years Mid-Continent Pipe Line Co.'s pumping practices have been revamped to gain faster pipe-line service for producing properties. Mechanical changes for this program aim at:

1. Mobility—so as to quickly connect with producers' tanks.
2. Flexibility—so as to readily adapt to variations in demand.
3. Interchangeability—so as to achieve ease in operation and avoid trouble which comes with burdensome stocks of spare parts.

The Mid-Continent Pipe Line Co. system operates entirely within Oklahoma for the purpose of gathering and transporting crude oil from producing leases to the company's refinery at Tulsa and for the usual exchanges of shipments with other pipeline systems. It is therefore "custom built" for Oklahoma conditions.

Particularly important in the revamping program has been the extensive use of fast connection methods, time shutdown switches and the standardization of skid-mounted pumping units.

Pumping units of all types and capacities up to and including 350 hp. are now mounted on skids in a manner which permits disconnection and removal within 3 hours. Rotary pumps have proved to be valuable in gathering-line service, especially where low investments and low discharge capacities are required.

While rotary pumps are mechanically less efficient than piston pumps, the many advantages of the rotary pump contribute substantially to the over-all effectiveness and economy of a gathering system. A pump of this type is so light and compact that it can be picked up by one man who can transport it to his pickup truck, thus eliminating in many cases the need for the larger gang truck and pipe-line gang required to handle and install a piston pump of the same capacity. A rotary pump is simple to install, replace, or interchange, and in most cases, the changes can be accomplished without welding. Ease of maintenance and the use of interchangeable parts reduces cost to a minimum. It is practicable to completely rebuild a rotary pump in the field in 3 or 4 hours. By the easy changes of sheaves on the engine, the rotary may be readily adapted for handling various capacities.

On long suction lines a mile or more in length where gravity operation is unsatisfactory, the company's practice is to use centrifugal or rotary pumps with spring-loaded bypass to boost the crude oil into the suction of piston-type discharge pumps. From an operating standpoint, the centrifugal naturally has the advantage in such service of not being a positive-displacement pump. Many tanks on gravity lines, of course, have the usual shutoff valves.

Quick pump connections are vital for moving oil as early as possible from new production. While the present practice is to connect at 30-hp. unit within 2½ hours after unloading at location, efforts are being made to cut this to 1 hour—perhaps without the use of welding.

Tank-truck service, utilizing flexible hose connections for tanks makes it possible for our company to move oil in the early stages of production development when there is some uncertainty as to whether oil will be produced in sufficient amount to justify laying a line. Such tank-truck service is unusual for pipe-line companies generally. But is has proved useful for both pipe-line-construction economy and service to producers.

Time switches are installed on all of the company's field-gathering-line pumps at tank batteries. These are clock-actuated mercury, magneto shutoff units which have been found to function more satisfactorily than gas shutoff switches. After the magneto switch is shut off, the gas is automatically shut off by a tell-tale regulator. Time switches are set to shut off a pumping unit when the oil level in the tank drops to the usual shutoff level of 10 to 12 in. above the bottom of the tank. These time switches eliminate the need for having gagers return to shut down the pumping units at the tanks.

Automatic controls on all pumping units shut down when lubricating-oil pressure is too low or jacket water temperatures are too high.

Standardization for ready inter-

(Continued on page 314)

THE AUTHOR

Alva C. Smith, superintendent of mechanical department, Mid-Continent Pipe Line Co., is in charge of both installation and maintenance of engines and pumps. He joined the company as foreman in 1944 after 7 years with Sinclair Refining Co. where he participated in early stages of construction of its products pipe line. He graduated from Oklahoma A. & M. College in civil engineering. He has a degree in mechanical engineering from International Correspondence Schools.

Hand-line gaging is carried out in four phases.

Float-operated gages are convenient for reading.

Measuring and Sampling *petroleum products*

A discussion of the methods used in accounting for movement of products in a pipe-line system

by T. R. Malone

FOR efficient and economical operation, sizable storage vessels are necessary at intake, outlet, and intermediate points in a petroleum products pipe-line system. This is particularly important where working storage is located at the junction of two or more lines.

The volumes received or delivered and those handled through the pipeline working storage must be accurately accounted for by some means. This can be accomplished by either or both of two methods, viz: metering or gaging. This article deals exclusively with the latter.

Gaging Practices and Related Functions

Each of the volumetric gaging methods in general use today by the petroleum industry has certain advantages and disadvantages. These methods may be divided into three categories:

1. Hand line or pole.
2. Float-operated gages for reading at the tank.
3. Remote-reading automatic gages.

Hand line or pole.—This method carries the least initial investment. Its greatest advantage is that water content and temperature can be determined during the operation of taking the gage. Necessary samples can also be withdrawn. Thus, all four phases of the gaging work are accomplished in the one trip. These are the essential factors that must be considered in computing net volumes of products in any storage container.

The disadvantages of the hand line or pole method are the costly man-hours involved in walking to and from tanks, climbing ladders or stairways and accumulating the necessary data, as well as the human element of error in correctly reading the gage tape or pole.

Float-operated gages.—For reading at the tank these gages have a higher initial investment than the hand line or pole method. They provide a very effectual time-saving means of ascertaining the hourly movement from or into the tank, by eliminating the climb to the top of the tank for this purpose. However, they afford no means of determining water content and temperature. Neither do they compensate for changes in specific gravity of the product.

Remote-reading automatic gages.—These have the highest investment cost of all three. Their great advantage is that gage readings can be taken from any one or all of a battery of tanks from a centrally located point at any desired period in a fraction of a minute's time. Like the float-operated gages, however, they provide no means of obtaining the other essential data.

It is logical, therefore, when and where water content, temperature, and specific gravity of product enter into the calculations that the hand gage be taken during the operation of obtaining the other necessary data.

The products-pipe-line department of Sinclair Pipe Line Co. utilizes meters and/or one of the three gaging methods for hourly accounting of products movements through its lines.

At such points where the pipe line takes custody of the products and where such products are delivered at the various outlets, the accounting is on the basis of hand gages, because in these instances the other essential factors: water content, temperature, and gravity of products will affect the net volumes received or delivered. Samples must also be obtained for flash-point tests of distillates.

The basic requisite for volumetric determinations by gages of any type is accurate strapping of the storage container. Sinclair Pipe Line Co. performs this function with its own trained personnel, men with years of experience at this particular work.

Gaging Procedure

Hand-line gages are made in strict conformity with the provisions of A.P.I. Code 25, using regulation steel tape and nonspark graduated plumb bob. Water-indicating paste is applied to bob or tape a few inches above and below the presumed water level. Having ascertained beforehand by an outage gage the approximate liquid level, tape and bob are then lowered into the tank until the approximate liquid-level depth is reached by the tape, when an oil-indicating paste is then applied to tape in the same manner as the water-indicating paste. Lowering of the tape and bob is then continued until the tip of the bob just touches the bottom of the tank.

During the lowering process the ungraduated side of the tape is kept in contact with the rim of the gaging hatch or tube at an established reference point, until the bob is within a short distance from the bottom. Five to ten seconds are required for the water and product to react on the indicating pastes. Tape is then read at the reference point and any variance from the established over-all gaging depth is noted. Tape is then withdrawn quickly and product and water levels read and recorded.

Use of chalk on tape for obtaining product level is not permitted as the product has a tendency to creep on a chalked tape. On all low-pressure tanks the over-all gaging height is stenciled on gaging hatch or tube at at established reference point and a swinging gage is also taken for a double check and to assure that no

obstructions exist on the floor of the tank at point of gage.

Floating-roof tanks are equipped with a slotted gaging tube flared at the bottom and anchored to the floor of the tank. This tube extends through the customary gaging hatch or auxiliary opening to a level with the hand rail at top of tank platform. This arrangement permits the taking of gages, temperatures, and samples from the platform at top of tank and eliminates the necessity of performing such duties from the floating roof, with its toxic-vapor hazard, particularly, when roof is on a support.

Tank tables for floating-roof tanks are computed on the basis of roof displacement of product of 60° A.P.I. gravity. Volumes of products with A.P.I. gravities above or below this figure are calculated by subtracting or adding to the table computations the proper amount for each decimal of a degree variation from 60° A.P.I. Each tank table carries this necessary information.

Temperatures are taken with a wood-back cup-case thermometer according to the specifications and provisions of the A.P.I. code. However, tests are currently being made with various types of temperature devices in different locations within the tanks, both horizontally and vertically, to determine the most accurate means of procuring this essential information. It is this phase of petroleum accounting that great inaccuracies can occur. On a tank of 75,000 bbl. of gasoline falling within Petroleum Group 3, an incorrect temperature reading of 1° will result in a plus or minus of 45 bbl.

Sampling procedure for determination of A.P.I. gravity (and flash-point tests for distillates) is carried out by running an unstopped bottle from the top of the product to the bottom of the suction outlet and return at a rate such that bottle will be almost full when withdrawn.

THE AUTHOR

T. R. Malone is assistant chief dispatcher of the products division of Sinclair Pipe Line Co. His first experience in pipe lining was with National Transit Co. in the Titusville and Bradford, Pennsylvania, oil fields, with which concern he spent nearly 20 years. In 1920 he joined Sun Oil Co.'s Susquehanna Pipe Line in New York State. He resigned in 1942 to go with the products pipe line of Sinclair Refining Co. He served as district chief dispatcher and as division chief dispatcher. In July 1950 he was transferred to the home office in Independence, Kans., and his present position.

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Improved Methods for Gathering-Line Service

(Continued from page 312)

changeability of parts has been planned in connection with the operation of the company's system in four districts.

Pump-unit skid dimensions are standardized. Furthermore, piping connections are standardized. Units are planned so that each will contain all items needed for connection and operation.

Pump and Engine Types

Of the 480 pumping units on the company's system, approximately 189 units have rotary pumps. There is 101 centrifugal units and approximately 190 piston pump units.

The rotaries are now in three different sizes of capacities between 15 and 70 bbl. per hour. These three sizes are to be reduced to two sizes in the standardization program.

The policy is to buy water-cooled engines for 12-hp. and above and air-cooled engines for the smaller sizes. Altogether the field-gathering engines are of eight different sizes, ranging from 12 to 280 hp.

Gathering-line costs, being necessarily high in comparison with other crude-oil pipe-line-transportation costs, present a challenge to engineers.

Survey of Pipe-Line Construction

More than 20,000 miles of projects, domestic and foreign, completed this year and under way, make 1951 another record-breaking year for pipe lining

by Paul Reed

THROUGHOUT the world, pipe-line projects completed in 1951 and under way total approximately 20,300 miles. This indicates that the total volume of pipe-laying undertakings will be comparable this year to the two previous record-breaking years. For completed projects in 1949 totaled 19,570 miles; in 1950, they were 19,240 miles.

Prospects indicate that 1952 will be another big pipe-line-construction year in spite of government regulations which have been impeding supplies of pipe to certain large projects in the second half of this year.

The 20,300 miles completed and under way in 1951 includes 17,100 miles for domestic projects and 3,200 miles for foreign.

The 17,100 miles of domestic projects includes 2,900 miles for crude oil, 2,800 miles for products, and 11,400 miles for natural gas.

The 3,200 miles of foreign projects completed and under way includes 1,550 miles for crude oil, 600 miles for products, and 1,050 miles for natural gas.

Plans and proposals for future work have been made for 30,700 miles, including 20,500 miles in the United States and 10,200 miles abroad. There are several competing proposals, particularly in western Canada, for crude oil and natural gas which represent some duplication because final granting of permits would eliminate some of these proposals.

In the United States, projects contemplated for the future include 3,550 miles for crude oil, 2,400 miles for products, and 14,550 miles for natural gas.

The 10,200 miles of foreign proposals includes 3,600 miles for crude oil, 1,200 miles for products, and 5,400 miles for natural gas.

Natural-Gas Lines Active

This year is one of the most active in natural-gas-line construction. The Texas Illinois Natural Gas Pipe Line Corp. and Trunkline Gas Co. systems commenced last year are being completed this year. Tennessee Gas Transmission Co. has carried on a large looping program as well as the extension from Buffalo to the Boston area in connection with its affiliate, Northeastern Gas Transmission Co. Texas Eastern Transmission Corp. is engaged in building a line from Mississippi to Pennsylvania which will be served by the United Gas Pipe Line Co. 1,000-mile expansion program.

The largest undertaking in products pipe lining is the Plantation Pipe Line Co. 707-mile, 18 and 14-in. line which departs from precedent for this type of transportation. Phillips Petroleum Co. is constructing sections to form a line to parallel its existing products system.

The Iraq Petroleum Co. 556-mile, 30-32-in. Kirkuk-Banias line now being laid for completion next year is of great significance for Middle East crude-oil movements. The prospects for construction of the proposed Middle East Pipe Line 800-mile 34-36-in. appear to be uncertain.

Emphasis will be put on large crude-oil pipe-line projects during the remainder of this year and the first half of next year. Platte Pipe Line Co.'s 1,075-mile line begun early in 1951 will be completed next summer. Early construction is expected for Sinclair Pipe Line Co.'s Drumright-Chicago 674-mile, 22-24-in.; West Texas Gulf Pipe Line Corp.'s 581-mile, 20-24-26-in.; and Rancho Pipe Line System's 464-mile, 24-in. Service Pipe Line Co. has scheduled 300 miles in six projects of 8 to 20 in. in diameter for completion by the end of this year.

The four crude-oil projects just mentioned total together about 2,000 miles. In connection with these undertakings a considerable amount of gathering-line construction is expected.

Since the needs of petroleum lines are being favored in the national program, the strongest demand in the first half of 1952 will naturally be for pipe of diameters below 12 in. Next in demand appears to be pipe in diameters between 12 and 20 in. While preference is given to petroleum lines, particularly for the first part of 1952, the prospects are nevertheless good for large-scale natural-gas-line construction which continue to have a predominant program for approximately 20,000 miles of new construction in the United States and abroad.

TABLE 1—PRINCIPAL DOMESTIC CRUDE-OIL PROJECTS PLANNED AND UNDER WAY

Company—	Miles	Inch	Status	Contractor, location, and completion date
Gulf Refining Co.	87	14	Authorized	Lumberton, Miss., to Mobile. 1-1-52.
The Ohio Oil Co.	117	22	Authorized	Sheridan, Ind., to Lima, Ohio.
Pan American Pipe Line Co.	40	14	Authorized	Arden Station in Irion County, Texas, to Eldorado Sta. in Schleicher County, Texas. 6-52.
Pan American Pipe Line Co.	27	26	Authorized	Genoa to Texas City, Tex. 12-52.
Phillips Petroleum Co.	27	8	Authorized	Looping from Yale, Okla., to Thrall, Kans.
Platte Pipe Line Co.	1,075	16-20	Contracted	Worland, Wyo., to Wood River Ref. area in Illinois.
Platte Pipe Line Co.	573	16-20	Under way	R. H. Fulton & Co.—Sections 1, 2, 3, and 4—Winchester, Wyo., to Brule, Neb.
Platte Pipe Line Co.	142	20	Under way	Bishop and Lock—Section 5—Near Marysville, Kans., to Holdredge, Neb.
Platte Pipe Line Co.	100	20	Under way	Rumsey Bros.—Section 6—Northern edge of Kansas.
Progress Pacific Pipe Line Co.	900	24	Proposed	Permian Basin, West Texas to California.
Rancho Pipe Line System	464	24	Authorized	Co. crews.—McCamey to Houston, Tex. 1952. (Joint project with Sinclair Pipe Line Co., Pan American Pipe Line Co., Tidewater Pipe Line Co., Nantucket Pipe Line Co., and Phillips Pipe Co., with Shell Pipe Line Corp. handling construction and operation).
Rancho Pipe Line System	66	8	Authorized	Gohlke to Lagrange, Tex.
Roosevelt Oil & Ref. Corp.	22	4-6	Authorized	St. Helens to Norwich, Mich.
Service Pipe Line Co.	135	8-10	Under way	Old Glory field to Bowie, Tex.
Service Pipe Line Co.	29	20	Authorized	Drumright, Okla., to Humboldt, Kans. 12-51. Loop.
Service Pipe Line Co.	19	16	Authorized	Freeman to Sugar Creek, Mo. 12-51.
Service Pipe Line Co.	63	10	Authorized	Cogdell to Old Glory, Tex. 12-51.

TABLE 1—PRINCIPAL DOMESTIC CRUDE-OIL PROJECTS PLANNED AND UNDER WAY (Continued)

Company—	Miles	Inch	Status	Contractor, location, and completion date
Service Pipe Line Co.	30	20	Authorized	Freeman to La Plata, Mo. 12-51. Loop.
Service Pipe Line Co.	24	10	Authorized	Denton, N. M., to Wasson, Tex.
Sinclair Pipe Line Co.	674	22-24	Authorized	Drumright, Okla., to E. Chicago, Ind.
Texas-New Mexico Pipe Line Co.	75	8	Planned	Midland to Germania pool; Midland to Scarborough and Sweetie Peck area; and Crane sta. to McElroy area, W. Tex.
Texas-New Mexico Pipe Line Co.	55	8	Planned	Eunice to Covington and Saunders area, N. M.
Union Oil Co. of California	40	8-10	Planned	San Joaquin Valley and Los Angeles Basin.
West Texas Gulf Pipe Line Corp.	467	24-26	Authorized	26-in., Colorado City to Wortham, Tex.; 24-in., Wortham to Sour Lake, Tex. 10-52.
West Texas Gulf Pipe Line Corp.	114	20	Authorized	Wortham to Longview, Tex. 10-52.

TABLE 2—PRINCIPAL DOMESTIC PRODUCT PROJECTS PLANNED AND UNDER WAY

Bell Oil & Gas Co.	150	6	Planned	Ardmore to Drumright, Okla.
Buckeye Pipe Line Co.	430	14	Proposed	Linden, N. J., to Allentown, Pa., on to New York. 1953.
The Ohio Oil Co.	24	8	Authorized	East St. Louis to Wood River, Ill.
Phillips Petroleum Co.	163	12	Under way	Looping from Borger, Tex., to Paola, Kans. 11-1-51.
Phillips Petroleum Co.	137	10	Under way	Looping from Paola, Kans., to E. St. Louis, Ill. 11-1-51.
Phillips Petroleum Co.	198	8	Under way	Looping from E. St. Louis, Ill., to E. Chicago, Ind. 11-1-51.
Plantation Pipe Line Co.	707	14-18	Under way	Williams Bros.—Baton Rouge to Charlotte, N. C.
Plantation Pipe Line Co.	275	14	Under way	Williams Bros.—Bremen to Charlotte, N. C. 10-51.
Plantation Pipe Line Co.	432	18	Under way	Williams Bros.—Baton Rouge to Bremen, Ga. 9-51.
Plantation Pipe Line Co.	220	18	Contracted	Williams Bros.-Davis Co.—Baton Rouge, La., to Miss.-Ala. state line.
Plantation Pipe Line Co.	200	14	Under way	Williams Bros.-Davis Co.—Winder, Ga., to Charlotte, N. C. 10-1-51.
Progress Pacific Pipe Line Co.	900	12-16	Proposed	California to W. Tex.
Salt Lake Pipe Line Co.			Proposed	Pasco, Wash., to Puget Sound.
Sinclair Pipe Line Co.		8	Proposed	Sinclair, Wyo., to Salt Lake City, Utah.
Sinclair Pipe Line Co.		10	Proposed	Houston to Baton Rouge.
Sinclair Pipe Line Co.		16	Proposed	Kalamazoo to Detroit.
Sinclair Pipe Line Co.		20	Proposed	Marcus Hook to Bayonne, N. J.
Sinclair Pipe Line Co.			Proposed	East Chicago to South Bend, Ind.
Standard Oil Co. (Indiana)	144	8	Under way	Neodesha, Kans., to Sugar Creek, Mo. 1-52.
Tuscarora Oil Co., Ltd.	61	10	Authorized	Pipe Line Const. & Drilling Co.—Knappenberger to Midland, Pa.
U. S. Army Engineers	190	$6\frac{5}{8}$	Under way	Associated Pipe Line Contractors, Inc.—Searsport to Limestone, Me. 10-15-51.

TABLE 3—PRINCIPAL DOMESTIC NATURAL-GAS PROJECTS PLANNED AND UNDER WAY

Algonquin Gas Transmission Co.	276		Proposed	Greenwich, Conn., to Boston area.
Algonquin Gas Transmission Co.	492		Proposed	Laterals—New England area.
Associated Natural Gas Co.	88		Planned	Missouri.
Carolina Natural Gas Corp.	185	2-12	Proposed	Lateral lines off Transcontinental in North and South Carolina.
Cities of Booneville and Baldwin, Miss.	96	3-4-6	Under way	M. L. Hulcher Co., Inc.—Booneville and Baldwin, Miss. 11-1-51.
Cities Service Gas Co.	177	4-30	Under way	Vaughn & Taylor Const. Co., Inc.—Grant, Stanton, Hamilton, Kearny, and Finney counties, Kansas. 11-15-51.
Cities Service Gas Co.	80	4-22	Under way	Check Const. Co.—Grant, Haskell, and Seward counties, Kansas.
City of Florence, Ala.	150	2-8	Under way	Modern Welding Co., Inc. 10-51.
City of Athens, Tenn.	40	1-8	Under way	Modern Welding Co., Inc. 11-51.
City of Gallatin, Tenn.	30	1-6	Authorized	Modern Welding Co., Inc.
City of Decherd, Tenn.	20	1-4	Authorized	Modern Welding Co., Inc.
City of Winchester, Tenn.	30	1-6	Authorized	Modern Welding Co., Inc.
Coast Counties Gas & Electric Co.	40	3-4-8	Considered	Coast and Valley region, California.
Colorado Interstate Gas Co.	250	20	Under way	R. H. Fulton & Co.—Kit Carson, Colo., to Amarillo, Tex.
Commonwealth Natural Gas Corp.	537	20	Proposed	West Bend, Ky., to Norfolk, Va.
Consolidated Gas Utilities Corp.	24	$10\frac{3}{4}$	Authorized	Marlow field to Fort Sill, Okla.
Dow Chemical Co.	70	various	Under way	Mahoney Contracting Co.—Area of Midland, Saginaw and Bay City, Mich.
East Ohio Gas Co.	65	26	Under way	Williams Bros. Corp.—Near Petersburg to Cleveland, Ohio. 12-1-51.
East Tennessee Natural Gas Co.	100	16	Planned	Knoxville to Kingsport, Tenn.
East Tennessee Natural Gas Co.	172	22	Proposed	Greenbrier to Oak Ridge, Tenn.
Egyptian Natural Gas Co.	80	6-8	Authorized	Norris City to Salem, Ill. 1951.
El Paso Natural Gas Co.	470	24	Under way	San Juan basin, N. M., to Franconia, Ariz. 10-1-51.
Empire Southern Gas Co.	22	2-3-4	Authorized	Ozona, Crockett Co., Tex., to Ozona distb. system.
Grand Valley Pipe Line Co.	105	8-10	Contracted	Piceance Creek field to Rifle on to Grand Junction, Colo.
Gulf Michigan Transmission Corp.	680	30	Proposed	Perryville, La., across Arkansas, Missouri, and Illinois to terminus near St. John, Ind.
Interstate Power Co.	26	8	Proposed	From Natural Gas P. L. Co. of America line near Hooppole, Ill., to Clinton, Iowa.
Iowa-Illinois Gas & Electric Co.	41	10	Proposed	Washington Co., to Cedar Rapids, Iowa.
Kansas-Nebraska Natural Gas Co., Inc.	65	2-8	Planned	Big Springs field to Ogallala, Neb., and Ovid, Colo.
Kansas-Nebraska Natural Gas Co., Inc.	39	4-$6\frac{5}{8}$	Authorized	Jayhawk Const. Co.—Neligh to O'Neill, Neb. 1952.
Kansas-Nebraska Natural Gas Co., Inc.	$54\frac{1}{2}$	4-$6\frac{5}{8}$	Authorized	Neligh to Hartington, Neb. 1952.
Kansas Power & Light Co.	27	20	Authorized	Pratt, Kans., to Calista Comp. Sta.
Lion Oil Co.	140	6-30	Under way	George Tucker Pipe Line Const.—gathering system for Diamond "M" Sharon Ridge refinery.
Manufacturers Light & Heat Co.	78	16	Under way	Britton Contracting Co.—Berwindale to near Saltsburg, Pa.
Michigan Consolidated Gas Co.	180	24	Planned	Austin to Detroit, Mich.
Michigan Consolidated Gas Co.	131	24	Under way	Anderson Bros. Corp.—Austin Storage Fields to Detroit, Mich. 11-1-51.
Michigan Gas Storage Co.	94	8-24	Authorized	Laingsburg to Mt. Clemens, Mich.

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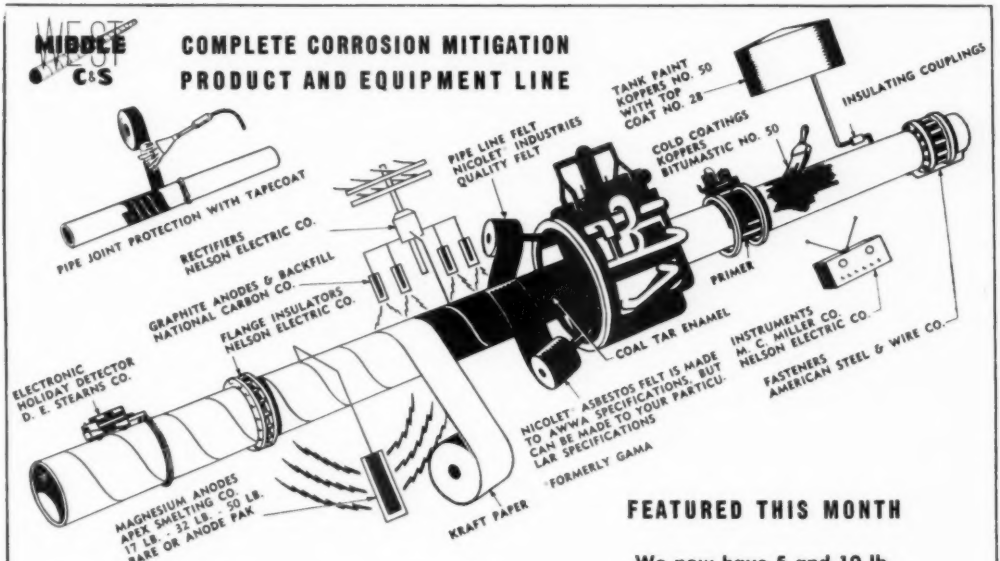
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TABLE 3—PRINCIPAL DOMESTIC NATURAL-GAS PROJECTS PLANNED AND UNDER WAY (Continued)

Company—	Miles	Inch	Status	Contractor, location, and completion date
Mississippi River Fuel Corp.	40	18	Authorized	Dubach to Perryville, La.
Mississippi River Fuel Corp.	96	18-16	Under way	Houston Contracting Co.—Ruston, La., to Marshall, Tex.
Montana Power Co.	52	16	Proposed	Canada-Montana Border to Cut Bank, Mont.
National Utilities Co. of Michigan	76	20	Proposed	South Central Michigan (22 miles from near Marshall south to Coldwater; 20 miles east to Hillsdale; 22 miles southwest to Sturgis; 5 miles from Hillsdale to Jonesville and 6 miles west to Union City).
Nevada Natural Gas Pipe Line Co.	114		Proposed	Topock, Ariz., to Las Vegas, Nevada.
New River Gas Co.	50		Planned	Summers or Monroe Counties, W. Va., to Narrows and Dublin, W. Va.
New York State Natural Gas Corp.	82½	20	Contracted	Williams-Austin Co.—Utica to Ithaca, N. Y. 11-15-51.
New York State Natural Gas Corp.	85	16	Contracted	Williams-Austin Co.—Utica to Albany, N. Y.
New York State Natural Gas Corp.	23	20	Contracted	Williams-Austin Co.—State Line Sta. to Angelica, N. Y., office, Wellsville, N. Y., 10-51.
New York State Natural Gas Corp.	39	16	Under way	Williams-Austin Co.—Amsterdam to Albany, N. Y.
New York State Natural Gas Corp.	56	20	Under way	Williams-Austin Co.—Morrisville to Ithaca, N. Y.
New York State Natural Gas Corp.	26	20	Authorized	New Kensington to South Bend, Pa.
New York State Natural Gas Corp.	51	20	Authorized	New Kensington, Pa., to Ohio line.
New York State Natural Gas Corp.	23	16-20	Authorized	Pipe Line Const. & Drlg. Co.—Waynesburg to Colvin Gate, Pa.
New York State Natural Gas Corp.	37	20	Under way	Williams-Austin Co.—Lawrenceville, Pa., to Ithaca, N. Y.
New York State Natural Gas Corp.	27	16	Authorized	Looping in Greene and Westmoreland counties.
New York State Natural Gas Corp.	70	20	Authorized	No. Oakford, Pa., to Ohio State line.
New York State Natural Gas Corp.	39	20	Under way	Williams-Austin Co.—Potter Co., Pa., to Livingston and Monroe counties, N. Y.
New York State Natural Gas Corp.	77	20	Under way	Williams Bros. Co.—Indiana, Pennsylvania, to Petersburg, Ohio. 10-31.
New York State Natural Gas Corp.	65	26	Authorized	Ohio-Pennsylvania State line northwesterly to Summit Co., Ohio.
Niagara Mohawk Power Corp.	40	10-12-16	Under way	Williams-Austin Co.—lateral lines in Utica, N. Y.
Niagara Mohawk Power Corp.	55	10	Under way	Williams-Austin Co.—Fulton to Watertown, N. Y.
Northeastern Gas Transissimon Co.	511	20-24	Authorized	New Hampshire, Massachusetts, and Connecticut.
Northeastern Gas Transmission Co.	124	24	Under way	Oklahoma Contracting Co.—New York-Mass. state line to point north of Boston, Mass.
Northeastern Gas Co.	411		Proposed	New England Towns.
Northern Indiana Fuel & Light Co.	33	8	Proposed	Edgerton to Auburn, Ind.
Northern Natural Gas Co.	370	4-26	Authorized	Gathering lines, Hugoton field.
Northern Natural Gas Co.	210	26	Proposed	Five loops, Texas-Okla., two in Kans., two in Neb.
Northern Natural Gas Co.	217	26	Under way	G. G. Griffis Const. Co.—Palymra, Neb., to Skellyville, Tex.
Northern Natural Gas Co.	181	4-12	Contracted	Reese Bros. Const.—gathering lines in Hugoton field.
Northwest Natural Gas Co.	750		Planned	Washington, Oregon, and Idaho.
Ohio Fuel Gas Co.	61		Proposed	Northern and southwestern Ohio, 16 miles in Erie, 8 miles, Warren and Montgomery, 13 miles in Madison and 23 miles in Lorain counties.
Ohio Fuel Gas Co.	22	16	Authorized	Dayton, Troy, Piqua, and Sidney, Ohio.
Ohio Fuel Gas Co.	74	3-20	Authorized	Hocking, Knox, and Ashland counties, Ohio.
Ohio Fuel Gas Co.	47	20	Authorized	Benton Township, Hocking County, to Columbus, Ohio.
Oklahoma Natural Gas Co.	40	16	Under way	Trojan Const. Co., Inc.—Ninnekah to County Line, Okla.
Oklahoma Natural Gas Co.	26	12	Authorized	Trojan Const. Co., Inc.—Ringwood to Enid, Okla. 1-52.
Oklahoma Natural Gas Co.	40	2-36	Authorized	Trojan Const. Co.—Ringwood field gathering system. 1-52.
Oklahoma Natural Gas Co.	23	24	Authorized	Trojan Const. Co.—Depew to Kellyville, Okla.
Pacific Gas & Electric Co.	141	34	Proposed	Parallel sections along Topock-Milpitas line.
Pacific Gas & Electric Co.	44	8	Under way	Salinas to King City, Calif.
Pacific Northwest Pipe Line Corp.	400	22		Gathering lines on Texas Gulf Coast to Pacific Northwest pipe line.
Pacific Northwest Pipe Line Corp.	2,175	26	Authorized	Wharton Co., Tex., via Okla., Kansas., Fort Collins, Colo., to Portland, Ore., Tacoma and Seattle, Wash.
Pan American Gas Co.	40	16	Under way	Anderson Bros.—Winnie to Texas City, Tex. 10-1-51.
Panhandle Eastern Pipe Line Co.	174	30-26	Contracted	R. A. Conyes—Tuscola, Ill., eastward looping present system.
Panhandle Eastern Pipe Line Co.	44	26	Contracted	Anderson Bros.—Looping on present system—Edgerton, Mich.
Panhandle Eastern Pipe Line Co.	22	30	Contracted	R. A. Conyes—looping in Tuscola, Ill.
Panhandle Eastern Pipe Line Co.	45	30	Contracted	R. A. Conyes—looping in Montezuma, Ind.
Panhandle Eastern Pipe Line Co.	63	30	Contracted	R. A. Conyes—Zionsville, Ind.
Panhandle Eastern Pipe Line Co.	70	24-26	Under way	R. H. Fulton & Co.—loops from Sneed, Tex., to Emporia, Kans.
Pennsylvania Gas Co.	52	12	Under way	Harford Bros.—Between Warren and Erie, Pa.
Peoples Natural Gas Co.	25		Proposed	Cambria and Blair counties, Pa.
Phillips Petroleum Co.	118	3-22	Under way	Vaughn & Taylor Const. Co., Inc.—Sherman and Hansford counties, Tex. Gas-gathering system.
Piedmont Natural Gas Co.	28	6	Proposed	North Carolina—laterals from Transcontinental Gas System.
Prince George's Gas Corp.	20	22	Authorized	Between Chillum and Rockville, Md.
Public Service Co. of N. C.	33	10	Authorized	Burlington to Chapel Hill, N. C. 3-1-52.
Public Service Co. of N. C.	16	8	Authorized	Chapel Hill to Raleigh, N. C. 7-1-52.
Public Service Co. of N. C.	29	4	Authorized	Statesville to Kannapolis, N. C. 7-1-52.
Public Service Co. of N. C.	83	8	Authorized	Kings Mountain to Asheville, N. C. 3-1-53.
Rockland Light & Power Co.	22	8	Proposed	Orangetown to Tomkins Cove, N. Y.
Southern California Gas Co.	22	22	Under way	Joe E. Young Pipeline Const. Co.—Simi to Santa Clara River. 10-51.
Southern California Gas Co.	24	30	Under way	Alex Robertson Co.—Inglewood to San Fernando Valley. 11-51.
Southern California Gas Co.	36	6-8	Contracted	Alex Robertson Co.—Palmdale to Mojave, Calif.
Southern California Gas Co. and Southern Counties Gas Co. of Calif.	81	30	Proposed	Whitewater to Desert Center, Calif., loops.

TABLE 3—PRINCIPAL DOMESTIC NATURAL-GAS PROJECTS PLANNED AND UNDER WAY (Continued)

Company—	Miles	Inch	Status	Contractor, location, and completion date
Southern Natural Gas Co.	169		Proposed	Ouachita Parish, La., to Augusta, Ga.
Southern Natural Gas Co.	20			Ouachita Parish, La.
Southern Natural Gas Co.	33			Ouachita and West Carroll parishes.
Southern Natural Gas Co.	108	14		Bass Junction to Augusta, Ga.
Southern Natural Gas Co.	21	24	Authorized	Perryville Sta., La., to Boeuf River.
Southern Natural Gas Co.	14	24	Authorized	Onward Sta., Miss., to Big Sunflower River.
Southern Natural Gas Co.	14	14	Authorized	Perryville Sta., La., to Wilhite Gate.
Southwest Gas Corp., Ltd.	26		Proposed	From Pac. G.E. Line to Victorville, Calif.
Sunray Oil Corp.	133	3-30	Under way	Vaughn & Taylor Const.—Snyder gasoline plant to Scurry County, Texas.
Tennessee Gas Transmission Co.	992	30	Planned	First 150 miles of loops to be laid at Monroe, La., Greenville, Miss., Midland and Portland, Tenn.
Tennessee Gas Transmission Co.	175	24	Under way	Oklahoma Contracting Co.—Albany to near Wilmington, Mass.
Tennessee Gas Transmission Co.	65	30-26	Under way	Oklahoma Contracting Co.—Falfurrias and Victoria, Tex.
Tennessee Gas Transmission Co.	158	30	Under way	Houston Contracting Co.—vicinity of Jones, La., on the north to near Cypress, Tex., on the south.
The Texas Co.	90	2-24	Under way	Holder Const. Co.—gas-gathering system. 10-15-51.
The Texas Co.	27	8	Authorized	Holder Const. Co.—Ventura to Fillmore, Calif.
Texas Eastern Transmission Corp.	791	30	Under way	Kosciusko, Miss., to Connellsville, Pa.
Texas Eastern Transmission Corp.	163	30	Under way	Williams Bros.-Davis Co.—Kosciusko, Miss., to Florence, Ala. 10-15-51.
Texas Eastern Transmission Corp.	100	30	Contracted	Mahoney Const.—Kentucky River to Ohio River, northeastern Kentucky. 10-15-51.
Texas Eastern Transmission Corp.	76	30	Under way	Eastern Pipe Line Contractors.—Florence, Ala., to Columbia, Tenn. 10-31-51.
Texas Eastern Transmission Corp.	73		Under way	H. B. Zachry Co.—Columbia, Tenn., to Cumberland River. 10-15-51.
Texas Eastern Transmission Corp.	79	30	Under way	Oman Const. Co.—Cumberland River to Columbia, Ky. 11-1-51.
Texas Eastern Transmission Corp.	80	30	Under way	N. A. Saigh Co.—Columbia, Ky., to Boonesboro, Ky. 10-15-51.
Texas Eastern Transmission Corp.	50	30	Under way	Trojan Const. Co., Inc.—Ohio River to Vanceburg, Ky.
Texas Gas Transmission Corp.	33	12	Authorized	Slaughters, Ky., to Evansville, Ind.
Texas Gas Transmission Corp.	189	26	Proposed	Gulf Coast region to southwestern La. Acadia Parish to connection with existing facilities in Moorehouse Parish.
Texas Gas Transmission Corp.	425	26	Proposed	Looping from Bastrop, La., to Hardinsburg, Ky.
Texas Gas Transmission Corp.	181	26	Under way	Houston Contracting Co.—Bastrop to Eunice, La.
Texas Gas Transmission Corp.	642	26	Proposed	Louisiana and Kentucky.
Texas Illinois Natural Gas Pipe Line Co.	1,300	30	Authorized	Corpus Christi area to Joliet, Ill.
Texas Illinois Natural Gas Pipe Line Co.	409	30	Under way	Bechtel Corp.—Arkansas and Missouri.
Texas Illinois Natural Gas Pipe Line Co.	106	30	Under way	Bechtel Corp.—Tex.-Ark. state line to Malvern, Ark. 10-15-51.
Texas Illinois Natural Gas Pipe Line Co.	130	30	Under way	Bechtel Corp.—Malvern, Ark., to Newport, Ark. 10-15-51.
Texas Illinois Natural Gas Pipe Line Co.	74	30	Under way	Newport, Ark., to Moark, Ark. 10-15-51.
Texas Illinois Natural Gas Pipe Line Co.	400	30	Contracted	H. C. Price—Trinity River to Texarkana.
Texas Illinois Natural Gas Pipe Line Co.	101	30	Under way	Midwestern Const., Inc.—(Schedule 11)—Moark, Ark., to Mississippi River near Chester, Ill. 10-15-51.
Texas Illinois Natural Gas Pipe Line Co.	102	30	Under way	Midwestern Const. Co.—(Schedule 12)—Miss. River (near Chester, Ill.) to St. Elmo, Ill. 10-15-51.
Union Gas & Electric Co.	35	8	Under way	O. R. Burden Contracting Co.—Bloomington, Ill., to Harris, Ill. Fall.
United Fuel Gas Co.	32	20	Under way	H. L. Gentry Const. Co.—Lanham to Broad Run, W. Va.
United Gas Pipe Line Co.	100	20-26-30	Contracted	J. Ray McDermott and Associated Pipe Line Contr., Inc.—Near Houma to Franklin, La.
United Gas Pipe Line Co.	50	16	Authorized	Baldwin County, Ala., southeasterly to Escambia County, Fla.
United Gas Pipe Line Co.	93	20-24-26	Authorized	Houston, Beaumont, and Orange, Tex.
United Gas Pipe Line Co.	315	24-30	Contracted	Oklahoma Contracting Co.—Agua Dulce to Point near Goodrich, Tex.
United Gas Pipe Line Co.	52	24	Authorized	Texas.
United Gas Pipe Line Co.		30	Contracted	Texas-La. Contractors—Gonzales, La., to Koscuisko, Miss. 11-51.
United Gas Pipe Line Co.		24	Contracted	Texas-La. Contractors.—Baxterville, La., to McComb.
United Gas Pipe Line Co.	510	20-30	Under way	Gulf Southern Contractors—Agua Dulce, Tex., to Monroe, La.
United Gas Pipe Line Co.	233	20-30	Under way	Gulf Southern Contractors—From Pure Oil Co.'s offshore platform Block 32 Eugene Island area to Jackson, Miss., comp. sta.
United Gas Pipe Line Co.	42	24	Under way	Gulf Southern Contractors—From Verna Sta., Miss., to Baxterville, Miss., dehydration plant.
United Gas Pipe Line Co.	52	20-24-26	Under way	Gulf Southern Contractors—Lirette to Napoleonville, La., to tie into Eugene Is. Jackson, Miss., 30-in. line.
United Gas Pipe Line Co.	60	12-16-20	Under way	Gulf Southern Contractors—LaFayette comp. sta. and Weeks Is. field to Franklin, La., to connect with 30-in.
United Gas Pipe Line Co.	59	30	Under way	Gulf Southern Contractors—Jackson comp. sta., Miss., to Texas Eastern Trans. Corp. proposed 30-in. line near Kosciusko, Miss.
United Gas Pipe Line Co.	124			Gulf Southern Contractors—Sterlington comp. sta., near Monroe, La., to Jackson comp. sta., Miss.
United Gas Pipe Line Co.	23	8-12-16		Gulf Southern Contractors—South Louisiana facilities.
Utah Natural Gas Co.	360	22	Proposed	San Juan basin area to Salt Lake City.
Virginia Natural Gas Co.	153			Buckingham to Richmond and Portsmouth, Va.
Westcoast Transmission Co., Ltd.	615		Planned	Oregon and Washington.
Western Kentucky Gas Co.		2-4	Under way	Modern Welding Co., Inc.—Additions to present system.
West Texas Gas Co.	27	10	Authorized	Lubbock to Abernathy, Tex.

Construction consists of two sections: Job #1, (81 miles) from Kosciusko to point above Houston, Miss., and Job #2, (82.5 miles) from Houston, Miss., to the Tennessee River above Barton, Alabama. Jobs feature extremely rough terrain and heavily wooded areas.

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TABLE 4—PRINCIPAL FOREIGN CRUDE-OIL LINES PLANNED AND UNDER WAY

Company—	Miles	Inch	Status	Contractor, location, and completion date
Alberta-Vancouver Oil Pipe Line Co. (Brokaw, Dixon, McGee)	972	16	Proposed	Edmonton via Pincher Creek, Alta., Idaho and Washington states to Vancouver, B. C.
Cia. de Petroleo Ganso Azul, Ltd.	48	4	Planned	Ganso Azul field to Pucallpa on Upper Ucayali River, Peru.
Condor S.p.a. (Shell)	80		Planned	Genoa to Rho, near Milan, Italy.
Direccion General y Yacimientos Petroliferos Fiscales	409		Under way	Plaza Huincul-Bahia Blanca, Argentina.
Independent Pipe Line Co.	721	16-18-22	Proposed	Edmonton to Vancouver.
Iraq Petroleum Co., Ltd.	556	30-32	Under way	Bechtel-Kirkuk—Kirkuk to Banias. 1952.
Mene Grande Oil Co.	15	16	Contracted	Chicago Bridge & Iron Co.—Oficina to Anaco.
Middle East Pipelines, Ltd.	800	34-36	Planned	Iran-Levantine Port.
Petroleos Mexicanos	145	13	Considered	Reynosa to Monterrey, Mexico.
Petroleos Mexicanos	100		Planned	Isthmus of Tehuantepec, Jose Colomo to El Plan field, Minatitlan.
Shell Caribbean Petroleum Co.	165	30	Under way	Williams Bros. Co. and Mahoney Contracting Co.—Pa'marejo to terminals on the Paraguana Peninsula (Cardon and Las Piedras, Vene.). 12-51.
Trans-Mountain Oil Pipe Line Co. (sponsored by Bechtel Corp.)	715		Proposed	Edmonton, Alta., via Yellowhead Pass to Vancouver, B. C.
Winnipeg Pipe Line Co., Ltd.	75	10	Under way	Sparling-Fowler Co., Ltd.—Gretna to Winnipeg, Manitoba, Canada.

TABLE 5—PRINCIPAL FOREIGN PRODUCTS LINES PLANNED AND UNDER WAY

Colombian Ministry of Petroleum	90	6	Planned	Puerto Berrio-La Dorada, Colombia.
Colombian Ministry of Petroleum	113	6	Contracted	Carolina Construction Co.—Puerto Berrio to Acedeo near Medellin, Colombia.
Colombian Ministry of Petroleum	75	4	Planned	Buena Ventura-Cali, Colombia.
Empresa de Ferrocarriles Ecuatorianos	50	5	Under way	J. A. Jones—Guayaquil to Palmira, Ecuador.
Estrada de Ferro Santos a Jundiai	32	18	Under way	Techint—Santos to Sao Paulo, Brazil. (Fuel-oil line) 12-51.
Governments of Southern Rhodesia and Portuguese East Africa	200		Considered	Beira, Portuguese Mozambique to Umtali, Southern Rhodesia.
Imperial Oil Co., Ltd.	195	10-12	Planned	Sarnia to London—Hamilton to Toronto.
Petrocongo (Sub. Cie. Financiere Belge des Petroles, S.A.)	225		Considered	Ango-Ango to Leopoldville, Belgian Congo.
Petroleos Mexicanos	156	10	Under way	Minatitlan to Salina Cruz, Mexico.
Societe des Transports Petroliers par Pipe Lines	140	10	Under way	Le Havre to Paris, France. 1952.
State of Cundinamarca, Colombia	120	6	Under way	Williams Bros.—Puerto Salgar to Bogota, Colombia.
Trans-Northern Pipe Line Co.	400		Planned	Hamilton to Toronto to Montreal, Que.

TABLE 6—PRINCIPAL FOREIGN NATURAL-GAS LINES PLANNED AND UNDER WAY

Azienda Generale Italiana Petroli	110	12-14-16	Planned	Cortemaggiore to Genoa.
Azienda Generale Italiana Petroli	110		Planned	Cortemaggiore to Bologna.
Azienda Generale Italiana Petroli	145	14-16	Under way	Cortemaggiore to Torino. 1951.
Canadian Delhi Oil Co. (sub. Delhi Oil Co.)	2,132		Proposed	Alberta, Toronto, Montreal.
Canadian Western Natural Gas Co., Ltd.	27	8	Under way	Co. crews.—Jumping Pound to Exshaw. 10-51.
Canadian Western Natural Gas Co., Ltd.	22	6	Under way	Co. crews.—Exshaw to Banff. 10-51.
Direccion General del Gas del Estado	310	8	Under way	Plaza Huincul to Neuquen, Argentina, to the vicinity of General Conesa, Argentina.
Northwest Natural Gas Co.	950	24	Planned	Alberta fields to Vancouver, B. C., Seattle, Wash., and Portland, Ore.
Petroleos Mexicanos	205	16	Under way	Monterrey to Torreon, Mexico.
Petroleos Mexicanos	260	20	Considered	Monterrey-Tampico-Poza Rica, Mexico.
Petroleos Mexicanos	600		Planned	Reynosa, Tamaulipas, Tampico, Poza Rica, Mexico.
Trans-Canada Pipe Lines, Ltd.			Proposed	Alberta to Toronto and Montreal.
Venezuela Atlantic Transmission Corp.	195	10-12-16	Under way	Williams Bros. de Venezuela, S. A.—El Placer near Las Mercedes, State of Guarico, to Caracas, La Guaira, Maracay, and Valencia.
Western Pipe Lines	1,200	22	Planned	Southern Alberta, Winnipeg, to Duluth, Minn.

TABLE 7—PRINCIPAL DOMESTIC CRUDE-OIL PROJECTS COMPLETED

Company—	Miles	Inch	Contractor, location, and completion date
General Petroleum Corp.	40	8	Bechtel Corp.—San Ardo to Estero Bay, Calif. 6-1-51.
General Petroleum Corp.	40	4	Bechtel Corp.—Estero Bay to San Ardo, Calif. 6-1-51. (Cutter stock)
Gulf Refining Co.	64	10	L. E. Farley, Inc.—Eucutta to Lumberton. 9-15-51.
Interstate Oil Pipe Line Co.	35	12	Houston Contracting Co.—New Iberia to Sunset, La.
Interstate Oil Pipe Line Co.	20	6-8	Houston Contracting Co.—New Iberia to Weeks Island and Avery Island field.
The Ohio Oil Co.	54	20	Bechtel Corp.—Wood River to Patoka, Ill.
The Ohio Oil Co.	74	20	R. A. Conyes Const.—Patoka to Martinsville, Ill.
The Ohio Oil Co.	109	22	R. A. Conyes Const.—Martinsville, Ill., to Sheridan, Ind.
Phillips Pipe Line Co.	53	8-6	O. R. Burden Const.—Wheeler to Sweeny, Tex. 1-1-15.
Phillips Pipe Line Co.	278	10	Brown-Lite and Arey-Phillips.—Borger, Tex., to Yale, Okla.
Phillips Pipe Line Co.	145	10	Arey-Phillips Co.—Borger, Tex., to Clinton, Okla. 6-1-51.
Phillips Pipe Line Co.	137	10	Brown-Lite Co.—Yale to Clinton, Okla.
Phillips Pipe Line Co.	24	8	C. H. Gragg Const. Co.—Thrall to Kansas City, Kans. 3-1-51.
Platte Pipe Line Co.	155	20	O. R. Burden.—(Section 7 and 8) Salisburg to St. Louis, Mo. 9-51.
Platte Pipe Line Co.	125	20	O. R. Burden.—Salisbury to St. Joseph, Mo. 9-51.
Service Pipe Line Co.	57	10	West Bank Salt Fork Brazos River to Jud Sta., Haskell Co., Tex. 9-15.
Service Pipe Line Co.	65	10	West Bank Salt Fork Brazos River to SPLCO's Bowie Sta., Montague Co., Tex. 9-15.
Sun Pipe Line Co.	30	4-6-8	Crosley and Hardey—Scurry Co. gathering. 5-51.
Texas Pipe Line Co.	56	12	R. H. Fulton & Co.—Wichita Falls to Chico, Wise Co., Tex. 1-15-51.

TABLE 8—PRINCIPAL DOMESTIC PRODUCTS PROJECTS COMPLETED

Great Lakes Pipe Line Corp.	355	12	Kansas City through Omaha and Sioux City, Ia., to Sioux Falls, S. D.
Great Lakes Pipe Line Corp.	107	8	A. C. Holder Const. and Geneva Const. Co.—Des Moines to Montezuma on to Iowa City, Ia.

Commercial Type CS Orifice Fittings

For Installation in

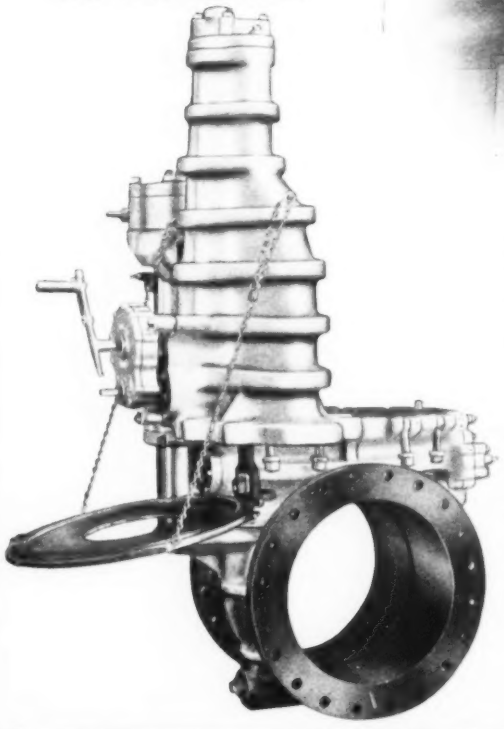
LARGE PIPE LINES and GASOLINE PLANTS

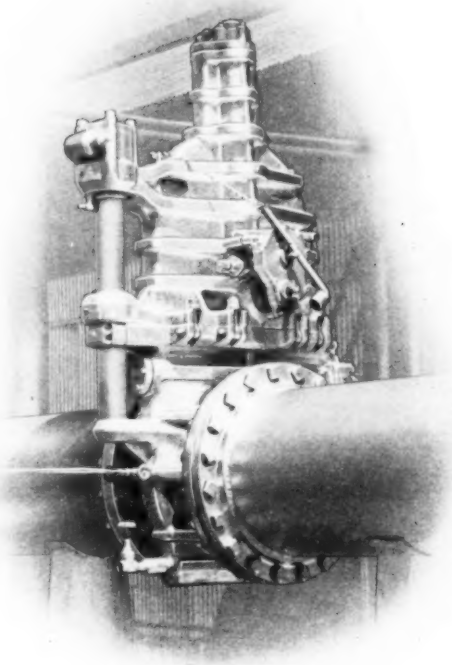
Furnished in Sizes 20" and Larger

125 lb. to 600 lb. ASA

Flanged or Welding Ends

Stainless Steel and Non-Corrosive Trim





Above: Commercial Type CS Orifice Fitting—24", 125 lb. ASA—installed at the Skelly Oil Company Gasoline Plant at Skellytown, Texas. A similar installation is at the Skelly Oil Company's Eunice, New Mexico, Plant.

Swinging Chamber Permits Easy *Pipe Line Level* Operation

As shown at left, the upper chamber swings aside for safe, easy, quick changing of the orifice disc. Handling heavy parts is eliminated. All controls are operated with a single wrench *at pipe line level.* Repacking of glands and replacement of parts (except plug and equalizing valves) is done under pressure, avoiding costly shut-downs. For illustrated description of design and operating procedure see pages 1280-1281 of your 1951 Composite Catalog, or write for new Catalog.

COMMERCIAL IRON WORKS

2424 Porter St., Los Angeles 21, Calif.

For Addresses of Distributors of "Commercial" Products refer to Page 1274 of the 1951 Composite Catalog.

TABLE 8—PRINCIPAL DOMESTIC PRODUCTS PROJECTS COMPLETED (Continued)

Company—	Miles	Inch	Contractor, location, and completion date
Miami-Valley Corp.	58	8	Anderson Bros. Co.—Dayton to Cincinnati. 1-1-51.
Phillips Petroleum Co.	50	8	Gragg Construction Co.—looping in Okla., Kans., and Mo. 5-51.
Plantation Pipe Line Co.	126	18	Williams Bros.-Davis Co.—Collins, Miss., to Baton Rouge, La. 8-31-51.
Plantation Pipe Line Co.	150	18	Williams Bros.-Davis Co.—Moundville, Ala., to Collins, Miss. 8-31-51.
Plantation Pipe Line Co.	87	18	Williams Bros.-Davis Co.—Moundville, Ala., to Coosa River, Ala.
Pure Transportation Co.	100	6	Wabash Const. Co.—Heath to Dayton, Ohio.
Standard Oil Co. (Indiana)	50	8	Lawhon Const. Co.—North of Sugar Creek, Mo.
Texas Pipe Line Co.	56	10	O. R. Burden Const. Co.—Lawrence, Ill., to Mt. Vernon, Ind. 7-1-51.
Triangle Pipe Line Co.	85	10	Anderson Bros. Corp.—El Dorado, Ark., to point on Mississippi River.
Tuscarora Oil Co., Ltd.	34	10	Pipe Line Const. & Drlg. Co.—Knappenberger Scraper Trap to Pittsburgh Junction, Pa.
Tuscarora Oil Co., Ltd.	27	8	Pipe Line Const. & Drlg. Co.—Pittsburgh Junction, Pa., to Midland, Pa.
Tuscarora Oil Co., Ltd.	26	10	Pipe Line Const. & Drlg. Co.—Barneytown Schaper Trap to East Freedom, Pa.
Tuscarora Oil Co., Ltd.	25	10	Pipe Line Const. & Drlg. Co.—Indiana, Pa.

TABLE 9—PRINCIPAL DOMESTIC NATURAL-GAS PROJECTS COMPLETED

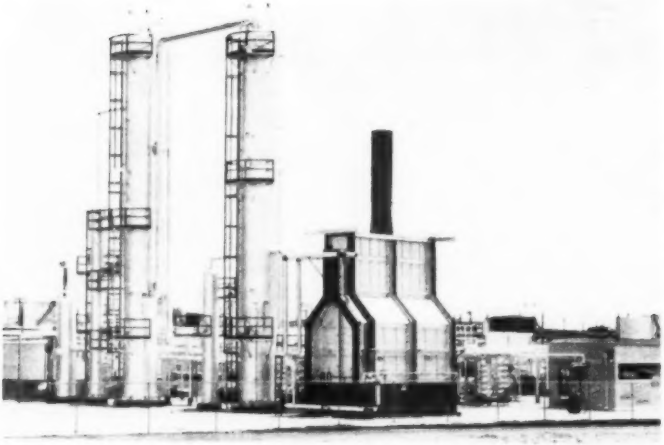
Cities Service Gas Co.	40	4-10	Knupp Const. Co., Inc.—Liberal, Kans.
Cities Service Gas Co.	29	16	Knupp Const. Co., Inc.—Hesston to Wichita, Kans. 6-51.
Cities Service Gas Co.	66	6-7-8-10	Knupp Const. Co., Inc.—Reclaim Hutchinson to Wichita, Kans.
Commonwealth Natural Gas Corp.	99	18	Ray L. Smith & Son.—Standardsville to Petersburg, Va.
Commonwealth Natural Gas Corp.	69	12¾	Ray L. Smith & Son.—Petersburg to Norfolk, Va.
Commonwealth Natural Gas Corp.	18	8	Ray L. Smith & Son.—Suffolk to Newport News, Va.
Delhi Oil Co.	68	8	Altgelt Const. Co.—Laredo to Lopeno, Tex. 4-1-51.
Hope Natural Gas Co.	32	8	Pipe Line Const. & Drlg. Co.—Terra Alta, W. Va., to Fairmont. 9-1-51.
Hugoton Production Co.	55	22 to 4	Reese Bros. Const. Co.—Near Ulysses, Kans., gathering system.
Humble Oil & Refining Co.	42	10	Houston Contracting Co.—Anahuac gasoline plant near Anahuac, Tex., to Gulf States Utilities plant near Beaumont, Tex.
Kansas-Nebraska Natural Gas Co., Inc.	22	12	Cheek Const.—Holcomb to Scott City, Kans.
Kansas-Nebraska Natural Gas Co., Inc.	34	12	Cheek Const.—Palco to Phillipsburg, Kans.
Kansas-Nebraska Natural Gas Co., Inc.	26	6	Jawhawk Const. Co.—Albion to Neligh, Neb.
Kansas-Nebraska Natural Gas Co., Inc.	60	8-10-12	Jawhawk Const. Co.—Grand Island to Albion, Neb.
Kansas Power & Light Co.	67	4-6-8	Greensburg to Fellsburg; reclaim of lines in Pratt, Fellsburg, and Stafford County, Kans.
Manufacturers Light & Heat Co.	66	16	Britton Contracting Co.—Berwindale to near Hyner, Pa. 8-1-51.
Manufacturers Light & Heat Co.	35	16	Britton Contracting Co.—Berwindale to Clearfield County, Pa. 8-1-51.
Manufacturers Light & Heat Co.	31	16	Britton Contracting Co.—East Bank of Moshannon Creek to near Hyner, Pa. 8-1-51.
Mid-South Gas Co.	40	12	Tulsa Const. Co.—Helena to Forest City, Ark. 3-1-51.
Missouri Central Natural Gas Co.	30	6	L. R. Young Const. Co.—Macon to Moberly, Mo.
Ohio Fuel Gas Co.	20	20	Somerville Const. Co.—New Albany to Homer, Ohio. 6-1-51.
Oklahoma Natural Gas Co.	40	16	Trojan Const. Co.—Velma to Chickasha, Okla. 5-1-51.
Oklahoma Natural Gas Co.	53	26	Trojan Const. Co.—Edmond to Depew, Okla. 3-15-51.
Southeastern Michigan Gas Co.	55	12	H. L. Gentry Const.—Birmingham to Port Huron, Mich. 5-15-51.
Southern Natural Gas Co.	120	16	Associated Pipeline Contr.—Mitchell Village, Ala., to Bolinbroke, Ga. 3-15-51.
Tennessee Gas Transmission Co.	175	24	Oklahoma Contracting Co.—Albany to near Wilmington, Mass.
Tennessee Gas Transmission Co.	156	24	H. C. Price.—Hamburg to Onondaga-Madison County line, New York. 8-1-51.
Tennessee Gas Transmission Co.	120	24	Bechtel Corp.—Hamburg to Hudson River, New York. 8-1-51.
Texas Eastern Transmission Corp.	36	20	E. J. Mahoney Contr. Co.—Connellsville, Pa., to Oakland Storage Sta.
Texas Illinois Natural Gas Pipe Line Corp.	98	30	H. C. Price.—Urbana to Garrison, Tex.
Texas Illinois Natural Gas Pipe Line Corp.	96	30	H. C. Price.—Garrison, Tex., to Tex.-Ark. state line.
Texas Illinois Natural Gas Pipe Line Corp.	100	30	Midwestern Const. Co.—St. Elmo to Bellflower, Ill. 9-17-51
Texas Illinois Natural Gas Pipe Line Corp.	90	30	Midwestern Const. Co.—Bellflower to Joliet, Ill. 9-5-51.
Texas Illinois Natural Gas Pipe Line Corp.	60	20	Midwestern Const. Co.—Joliet to Volo, Ill. 9-15-51.
Texas Illinois Natural Gas Pipe Line Corp.	100	26	Midwestern Const. Co.—LaGloria to Refugio, Tex.
Texas Illinois Natural Gas Pipe Line Corp.	110	30	H. C. Price.—Hungerford to Trinity River.
Texas Illinois Natural Gas Pipe Line Corp.	38	12	H. C. Price.—Old Ocean field to Chocolate Bayou field.
Texas Illinois Natural Gas Pipe Line Corp.	97	26	H. C. Price.—Hungerford to near Refugio.
Trunkline Gas Co.	186	26	Mahoney Contracting Co.—Tuscola to Joppa, Ill. 7-51.
Trunkline Gas Co.	18	26	Houston Contracting Co.—Lake Arthur to Lacassine, La.
Trunkline Gas Co.	42	16-20	Houston Contracting Co.—Lake Arthur, Longville to point north of Iowa, La. 1-1-51.
Trunkline Gas Co.	33	20	Houston Contracting Co.—Lake Arthur, La., to Lacassine, La.
Trunkline Gas Co.	33	20	Houston Contracting Co.—Longville to Lacassine La.
Trunkline Gas Co.	1,300	20-26	Includes 740 mi., 26-in., Lake Charles, La., to Tuscola sta., of Panhandle East. P. L. Co. and 1,035 mi., 10-24-in., Lake Charles, La., to McAllen, Tex.
United Gas Pipe Line Co.	30	30	Texas-La. Contractors.—Napoleonville to Gonzales, La. 7-51.
United Gas Pipe Line Co.	93	6-16	Brown & Root, H. C. Price, J. Ray McDermott.—Fields in Plaquemines Parish to near New Orleans.
United Gas Pipe Line Co.	54	20	Texas-La. Contractors.—Needville to Freeport. May 1.
York Gas Co. and Corning Glass Co.	30		Britton Contracting.—York, Pa., and Corning, N. Y.

TABLE 10—PRINCIPAL FOREIGN CRUDE PROJECTS COMPLETED

Basrah Petroleum Co.	72	12-16	Zubair to Fao, Iraq.
Petroleos Mexicanos	160	11	Minatitlan to Salina Cruz, Mexico.
Shell Caribbean Petroleum Co.	11	16	Bachaquero (North) to Lagunillas. 5-51.
Shell Caribbean Petroleum Co.	18	4	Mara to Palmarejo.
Shell Caribbean Petroleum Co.	16	14	Tia Juana to Cabimas (Hot Oil).

TABLE 11—PRINCIPAL FOREIGN NATURAL-GAS PROJECTS COMPLETED

Azienda Generale Italiana Petroli	30	8	Ferrara to Bologna. 7-51.
Direccion General del Gas del Estado	62		Comodoro Rivadavia-Caleta Olivia, Argentina.
Union Gas Co. of Canada, Ltd.	61	16	Shaw Construction Co.—Facilities, Dawn Township, County of Lambton, Province of Ontario. 9-51.



The new crude unit at Big Spring was erected in exactly 2 months.

Cosden Increases Capacity At Big Spring 20 Per Cent

New two-stage distillation unit is currently charging 4,200 bbl. per day of Benedum crude

A NEW two-stage crude-distillation unit has been placed in operation at the Big Spring refinery of Cosden Petroleum Corp. It was designed for a nominal capacity of 4,000 bbl. per day of sweet, high-gravity Ellenburger crude oil. This amounts to an increase of 20 per cent in crude charging capacity for the refinery.

Last January it was recognized that there would be on increased gasoline demand in West Texas. Crude runs at the Big Spring refinery were exceeding the capacity of the stills for continued operation. Since refinery operation was balanced with complete integration of all units, it was obvious that crude runs would have to be increased. A high-gravity crude distillate was available to the refinery by pipe line. This crude assays about 50 per cent gasoline, which indicated it would be ideally suited for an incremental charge of crude to increase gasoline production. An economic study showed a rapid payout for the 4,000-bbl. per day unit.

Process design was completed in February and the equipment immediately ordered. Vessels were delivered to the plant early in May, and were erected on previously prepared foundations. Construction was completed in exactly 2 months. The unit went on stream July 5, 2 days ahead of schedule. There was a total elapsed time of but 6 months from initial market survey to completion of the unit. This is believed to be a singular achievement in the industry.

One of the principal reasons for this achievement is the outstanding way in which the equipment suppliers cooperated with early deliveries.

The unit has performed very satisfactorily and has exceeded design capacity by 10 per cent. It is presently charging 4,200 bbl. per day of Benedum crude with the following yield:

Product—	Barrels per day	Per Cent
325 e.p. gasoline	1,890	45
300-400 e.p. naphtha	252	6
Kerosine	630	16
Gas oil	378	9
Topped crude	882	21
Gas and loss	168	4
	4,200	100

Though the gasoline yield is high, quality is poor. It has an F-1 octane, clear, of 55; with 3 cc. per gallon TEL, 76. Naphtha and kerosine are sweetened in a Perco copper chloride treater. Gas oil has a diesel index of about 68 and is an excellent blending component for diesel fuel. Topped crude is 29 -30° A.P.I. with a Conradson carbon of only 1 per cent. Salt and heavy metals content is very low so it is suitable for cat-cracker charge stock.

Corrosion protection and alternate heat-exchange trains were provided in design of the unit to permit operation with sour crude oil. This gives the unit a high degree of operating flexibility and increases its utility as a unit for incremental crude charge. Because of the high degree of automatic control provided, only one man per shift is required for operation. Operating cost is low and it appears to be a very economical operation. The deficit in gasoline supply for West Texas has been met with minimum loss of time and maximum realization of product per unit of investment.

Vessels and receivers for the new unit were fabricated by Wyatt Metal & Boiler Works. Pumps were furnished by Worthington Pump & Machinery Co., and heat exchangers by Griscom-Russell Co. and C. F. Braun Co. Fluor Corp. Fin-Fan condensers reduced the total cooling-water requirements of the unit to 170 g.p.m. Instruments were supplied by Foxboro Co. and control valves by Fisher Governor Co. The heater is a 10,000,000 b.t.u. per hour U.O.P. center-wall updraft type.

Process design and collaboration in drawing up equipment specifications was by Purvin & Gertz, consulting chemical engineers of Dallas. The refinery-engineering department did all plant layout work and made detail pipe drawings for shop fabrication. Refinery-maintenance forces prepared the site and did all construction work. It is interesting to note that the vessels were insulated on the ground. This obviated the necessity of scaffolding and greatly reduced the cost of the work.

Carbon-Black Project Nears Completion

English plant will make two grades of product

by V. S. Swaminathan*

THE largest carbon-black plant of its kind outside the United States, is now nearing completion at Avonmouth, England. Scheduled to start operations soon, this 50,000,000-lb. per year unit like the Cabot plant, near Stanlow, N. W. England, is being built with American assistance, the company concerned being Phillips Petroleum Co., of Bartlesville, Okla. The £1,500,000 capital raised for the project is wholly British, the arrangement being that a royalty will be paid to the American company.

Two grades of black will be pro-

*5, Fielding Road, Bedford Park, London, W.4.

duced at the Avonmouth plant. Philblack "A," for use in extruded rubber products such as cable sheathing is to be produced at the rate of 20,000,000 lb. annually. The remainder of black production is to be 30,000,000 lb. yearly of Philblack "O," a high-grade abrasive-resistant black for tires. Both types are well suited for compounding with natural and petroleum-derived synthetic rubber.

These two grades are made in separate units by a process differing only in details. The unit producing Philblack "O" is the larger of the two, with precipitators, cyclones, and related equipment installed side by side instead of in line as in the case of the Philblack "A" plant. From the cyclone stage both plants are housed in a steel-framed building.

The furnace process is employed for manufacture of Philblack "A." The process consists of burning a special imported petroleum fraction, totaling nearly 70,000 long tons a year, with partial exclusion of air and separating the carbon black from the products of combustion. The imported feed stock in pumped from tankers at the Avonmouth docks through a 3½-mile-long, 14-in., pipe line to the plant's three main storage tanks, each having a capacity of 8,000 tons. From storage the oil is pumped to a day tank and thence to the furnaces. Process air is supplied by three Keith Blackman centrifugal blowers powered with Westinghouse 550-hp. high-voltage motors. These units are installed in the pump house, and connected to a common manifold.

The oil is subjected to confined, partial combustion under controlled high-turbulence conditions at a temperature of about 2,500° F. in refractory-lined cylindrical furnaces. Products of combustion flow from the furnaces through atmospheric cooling pipes and back to a smoke header where temperature of gas falls to between 600° and 700° F. The gas stream then passes through a secondary quench tower consisting of a vertical cylinder with open water sprays where it is cooled to 500° F. A deflector plate in the quench tower traps heavy grit from the gases.

After preliminary cooling and cleaning, the carbon black-laden gas passes into electrostatic precipitators which are insulated to prevent undue condensation.

The electrical equivalent of a 75,000-volt d.c. field is obtained from the local a.c. supply through transformers and rotary rectifiers. The precipitators agglomerate the black so that it may be better handled by the cyclone collectors. However, approximately 30 per cent of black is collected by the precipitators. Two cyclone collectors take the gas from the precipitators and extract about 64 per cent of the black. This production joins that from the precipitators in a stainless-steel screw conveyor.

Tail gases from the cyclones pass through a bag filter plant which extracts the remaining 6 per cent of black leaving the gases sufficiently clean for release to atmosphere. The bag filter plant is manufactured by Air Control Installations, Ltd., to the specifications of American Air Filters Corp., following extensive pilot-plant tests carried out by Phillips Petroleum at its plant in Borger, Tex. The filtering elements consist of suspended bags of glass-fabric material.

The black from the precipitators, cyclones, and bag filter is conveyed by the screw conveyor to a micro-pulverizer to break down the grit particles. The pulverized material passes to a series of pelleting mills. The equipment used at the Avonmouth plant is dry pelletizers.

Before entering the pelletizing mills the black has a density of approximately 3 to 5 lb. per cubic foot. After pelletization, the density rises to 23 lb. per cubic foot. Pelletizing minimizes dust nuisance in subsequent handling. Also, in pellet form the black is much easier to compound into the rubber. Lastly the process results in cheaper packaging cost, and entails smaller warehousing space.

The pelletized black passes from mills to overhead storage hoppers from which it is packaged in multi-walled paper sacks by machines with exhausting devices which prevent the black from escaping into the atmosphere. One million paper bags will be required yearly for packing and 3.75 million Imperial gallons of oil for the manufacturing process.

In the initial stage of production fuel oil is to be used for heating. Eventually, it is planned to utilize waste gases from the carbon-black process in the boiler house so that the feed stock will provide both the raw material and the fuel. The ideal carbon-black raw material should contain a maximum of aromatics and, further, should be low in sulfur, substantially free from suspended ash or carbon, low in high-molecular-weight resins and asphaltenes, and substantially free from emulsifying water. Possibilities of utilizing coal-tar distillates, or oil fractions from domestic refineries, are under investigation so as to dispense with the need for imported feedstock.

Auxiliary facilities at the new Philblack tanks, water-cooling towers, fuel-oil storage, washing and changing facilities for workers, a canteen, office accommodations and a small and well-equipped laboratory.

Operating personnel for the plant will run to about 80 people at the start. Eventually a maximum of 110 persons will be employed.

Production from the Philblack plant will meet just over 50 per cent of United Kingdom carbon-black requirements, and nearly 8 million dollars a year will be saved by manufacture in this plant.

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and WINTER
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Assure high worker efficiency in low temperatures. Provide famous aluminum alloy "T" hat protection – plus – McDonald winter accessory comfort! Hat shell is ribbed for bonus-strength – comes in two sizes. Adjustable, totally suspended headband absorbs impact.

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Protects head and ears. Stout khaki lined with flannel.

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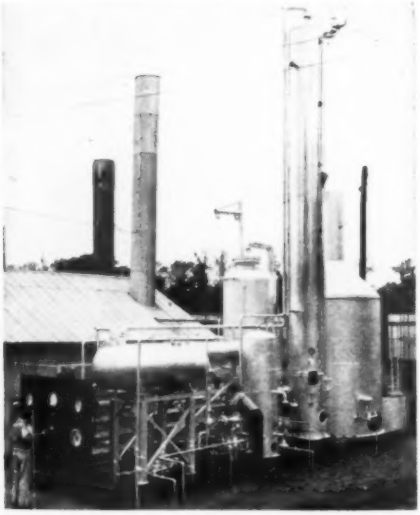
QUESTIONS on TECHNOLOGY

by W. L. Nelson
Consulting Engineer



Perco Cycloversion unit installed in plant of Evangeline Refining Co., Jennings, La.

Package Catalytic Units

Note.—Our answer of March 1, 1951, pertaining to "Refineries Not Package Units," stated too strongly that "the only package equipment are certain individual items such as pipe stills, gas-absorption plants, boilers, or compressors." There are undoubtedly many more items of "package unit" equipment, and it is called to our attention that certain catalytic cracking units are now substantially package units.

The photograph on this page shows the package unit of Perco Division of Phillips Petroleum Co. The Perco Cycloversion unit is skid mounted, and the unit shown in the photograph has a single catalyst chamber rated at 400 bbl. per stream day. Units up to 1,000 bbl. per day are shop fabricated and shipped to location completely assembled. When two catalyst chambers are provided as in the 650-bbl. per day Gladewater Refining Co. unit *(The Oil and Gas Journal, April 12)* it is obvious that the cycle time efficiency is better because continuous operation need not be interrupted to regenerate the catalyst.

The unit was shipped complete with the exception of the fractionator and debutanizer columns which were not erected until the skids were set on the concrete pad.

It is understood that these units have been used mainly in catalytically desulfurizing naphthas and gasolines. The Evangeline Refining Co. unit in the photograph has operated on distillate-type crude oil and on a 200°-450° F. naphtha, and the Gladewater unit has operated on cracked gasoline and a 475° F. end-point straightrun naphtha. Operation on the 475° F. naphtha resulted in an increase in leaded octane number (3 cc. TEL) of 11.4 octane number units and a yield of 90.4 per cent of debutanized gasoline based on the charge.

These units are package units in the sense that they are brought to the job as completed installations. The same applies to some extent to the derrick-mounted standard TCC catalytic units of Southwestern Engineering Co. and Socony-Vacuum Oil Co., Inc.

Storage of Boiler

Thanks for your item "Care of Idle Boiler." What if we want to take the boiler out of service for 6 months?—F. C.

A "dry method" of protection is also discussed by Conlan of the Betz company.

The dry method is preferable when a boiler is to be out of service for a month or more and will not be required for emergency purposes. The boiler should be drained, thoroughly cleaned, and carefully inspected to insure all is in good order. The boiler should then be thoroughly dried internally by means of hot air stoves or a light wood fire. An amount of quick lime, approximately 30 lb. for each 100 boiler horsepower, should be spread on watertight wood trays placed in the boiler immediately after the drying-out process. If the boiler is an HRT or locomotive type, a single-tray resting on top of the flues or in the bottom of the shell will be adequate. In a multidrum water-tube boiler, a tray should be placed in each drum. The manheads, handholes and all connections on the boiler should be tightly blanked or closed after the lime has been placed in position. If the boiler is idle for a considerable period, it should be opened every 3 or 4 months for examination and renewal of the quick lime if necessary.

Cracked Residuum Lighter Than Charge Stock

We have recently conducted viscosity-breaking experiments in which the residuum is higher in A.P.I. gravity than the charge stock. This seems to be contrary to usual results and we would like to know of your experiences. F.C.P.

Although the A.P.I. gravity of a cracked residuum that is produced by a recycling-type operation is almost invariably lower than the gravity of the charge stock, the reverse may occur in once-through cracking operations or even in recycling operations if the yield of gasoline is very low. This occurs because the boiling range of the cracked residuum is lower than the boiling range of the charge stock, Thus, even though the hydrogen content of the cracked residuum is lower than the charge stock, the residuum can, because of its low boiling range, have a higher A.P.I. gravity than the charge stock.

Recent fragramentary experiments confirm the above conclusions, but the tests are not complete enough to outline the situation in detail. It is also interesting to note that purely empirical formulas of yield versus gravity differences (A.P.I. of charge less A.P.I. of cracked residuum) have indicated the same possibility *(see Questions on Technology, July 22, 1948, page 94)*. The general kind of relationship is indicated in Fig. 1 here, which is the same chart as those shown on the Questions on Technology page of July 20, 1950, page 99, except that the chart shown here indicates an intercept on the yield axis rather than lines that lead to a zero per cent yield.

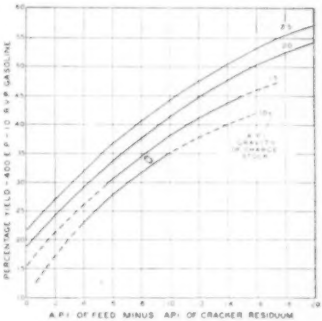


Fig. 1—Approximate thermal cracking yield as a function of the gravity of the feed and the cracked residuum.

Cost-imating

Costs Hold Steady After February

(Itemized Cost Indexes)

THE rise in costs of specific construction materials since 1946 may be ascertained from the cost indexes shown here. They were prepared by W. L. Nelson, Journal technical editor. Current prices of other construction items that appeared in the Cost-imating Series (October 21, 1948, weekly through December 29, 1949) may also be estimated from the cost indexes listed here. Similar cost indexes are published quarterly in the first weekly issues of January, April and July. Also, the Nelson Refinery Construction Index appears in the first weekly issue each month on the Refining page of The Oil and Gas Journal.

(Multiply the prices of Cost-imating series by these indexes)
Base: 1946 = 100

	1947	1948	1949	1950	May 1951	Reference	Complete index appears in Cost-imating
Labor:							
Skilled construction	112.0	125.0	133.9	140.0	146.1	Eng. News Record	No. 55—Nov. 3, 1949
Common labor	115.0	131.0	140.4	148.1	155.7	Eng. News Record	No. 55—Nov. 3, 1949
Refinery construction	113.5	128.0	137.1	144.0	150.9		No. 61—Dec. 15, 1949
Refinery operation	109.0	126.0	132.9	137.6	149.7	Survey of Current Business	No. 55—Nov. 3, 1949
Equipment or materials:							
Board insulation, 48-in.	112.5	125.0	125.1	129.8	136.5	Code 561	
Boiled tubes, 2-2¼-in.	115.0	†135.0	140.9	149.5	163.3	Code 409.2	
Brick and tile composite	114.0	137.0	131.4	137.1	147.1	Composite	No. 22—Mar. 17, 1949
Brick, common	110.5	127.0	133.1	138.2	147.1	Code 498.1	
Brick, fireclay	114.0	126.0	131.3	144.9	155.5	Code 499	
Building materials composite	135.5	153.0	145.8	155.4	171.8	Composite	No. 22—Mar. 17, 1949
Castings, gray iron	118.5	†139.5	†141.5	†160.0	†174.4	Code 416.9	No. 46—Sept. 1, 1949
Castings, pipe	129.0	†180.0	173.8	170.9	190.9	Code 434.2	No. 46—Sept. 1, 1949
Cement	110.0	125.0	128.2	131.2	141.4	Code 509.1	No. 22—Mar. 17, 1949
Compressor	114.0	128.0	120.0	116.8	138.1	Manufacturer	No. 36—June 23, 1949
Engines (composite)	109.0	120.0	115.5	117.9	137.1	Manufacturer	No. 36—June 23, 1949
Gas	111.0	122.0	117.0	121.8	134.6	Manufacturer	No. 36—June 23, 1949
Diesel	108.0	117.0	114.0	114.0	139.7	Manufacturer	No. 36—June 23, 1949
Exchangers	†115.0	†130.0	†133.0				No. 2—Oct. 28, 1948
Instruments (composite)	113.0	120.0	123.1	127.8	142.4	Manufacturer	No. 34—June 9, 1949
Flow meter, mechanical	102.0		109.2	114.0	126.8	Manufacturer	No. 34—June 9, 1949
Flow meter, air control			132.4	138.5	157.6	Manufacturer	No. 34—June 9, 1949
Flow meter, remote			130.2	135.5	151.7	Manufacturer	No. 34—June 9, 1949
Potentiometer, 6-ft.	111.0		125.8	134.0	146.6	Manufacturer	No. 34—June 9, 1949
Potentiometer, air control			131.6	134.1	136.8	Manufacturer	No. 34—June 9, 1949
Pressure controller			130.2	135.6	153.3	Manufacturer	No. 34—June 9, 1949
Pressure gage	109.0		100.0	101.2	108.6	Manufacturer	No. 34—June 9, 1949
Thermometer recording			118.6	124.0	144.3	Manufacturer	No. 34—June 9, 1949
Control valve	117.0		129.8	133.3	155.5	Manufacturer	No. 34—June 9, 1949
Insulation, asbestos pipe	118.0	122.0	130.1	137.9	162.9	Code 767	
Lumber (composite)	155.0	175.0	160.1	183.5	201.2	Composite	No. 7—Dec. 2, 1948
Cypress, C grade	155.0	178.0	213.5	†251.0	255.5	Code 529-2	
Pine, Ponderosa, No. 3	140.0	176.0	159.0	180.5	218.9	Code 524-1	
Pine, yellow timbers	138.0	161.0	154.8	†173.0	189.4	Code 522-9.1	No. 7—Dec. 2, 1948
Redwood, heart	134.0	†159.0	154.6	†181.0	191.5	Code 528-3	
Motors, electric	110.0	112.7	114.0	130.8	148.8	Manufacturer	No. 31—May 19, 1949
Paint and paint materials	137.0	135.0	127.5	119.8	138.1	Composite	No. 22—Mar. 17, 1949
Paint, inside, flat	133.5	137.0	147.0	146.5	163.2	Code 531-1	
Paint, outside	150.0	†156.0	157.0	147.0	161.0	Code 532-1	
Pipe, sewer	111.5	121.5	119.1	132.0	152.5	Code 572.1	No. 22—Mar. 17, 1949
Pipe, black, ¾-in.	120.5	†148.0	152.2	159.7	169.6	Code 435.1	No. 42—Aug. 4, 1949
Pumps (composite)	118.7	129.1	131.7	136.0	159.7	Manufacturer	No. 29—May 5, 1949
Centrifugal	109.0	120.0	118.0	128.1	136.2	Manufacturer	
Reciprocating	128.5	138.1	144.6	143.9	183.3	Manufacturer	
Sand	112.0	122.0	127.4	129.3	138.0	Code 579.2	
Steel (composite iron and steel)	121.0	140.5	150.2	155.2	168.5	Composite	No. 61—Dec. 15, 1949
Plate (tank)	117.5	†144.0	144.5	151.7	161.0	Code 446.3	No. 5—Nov. 18, 1948
Sheet, galvanized	105.0	†146.0	139.0	150.0	165.6	Code 448.3	
Structural	113.5	†145.0	151.3	162.7	172.5	Code 452.2	No. 18—Feb. 17, 1949
Transformers	116.0	116.0	116.0	116.0	130.5	Manufacturer	No. 31—May 19, 1949
Marshall-Stevens equipment (only) indexes:							
Process industries (average)	121.0	131.5	131.5	135.8	145.1	Chem. Eng., June 1951	Chem. Eng., Feb. 1951
Chemical	119.5	130.0	130.0	133.8	142.8	Chem. Eng., June 1951	Chem. Eng., Feb. 1951
Petroleum	121.0	132.0	132.0	136.5	145.9	Chem. Eng., June 1951	Chem. Eng., Feb. 1951
Electrical power	122.0	135.0	135.0	139.3	148.7	Chem. Eng., June 1951	Chem. Eng., Feb. 1951
Refrigeration	129.0	141.0	139.9	147.3	159.5	Chem. Eng., June 1951	Chem. Eng., Feb. 1951
Steam power	122.0	132.0	132.0	136.6	146.8	Chem. Eng., June 1951	Chem. Eng., Feb. 1951
Nelson—Refinery Construction	117.0	132.5	139.6	146.2	156.3		No. 61—Dec. 15, 1949

*The reference for all codes, or for composite, is "Wholesale Prices" published monthly by the Bureau of Labor Statistics, U. S. Department of Commerce. †Estimate.

CORROSION and its control

Criteria for Cathodic Protection

TO MAINTAIN a structure under complete cathodic protection, it is necessary that there be a negative charge at every point on the surface, available to neutralize the hydrogen ions which are in the soil or water. This charge must be kept at a level sufficient to neutralize all the hydrogen ions which may come that way, including those which will be attracted by the charge itself.

Another way of looking at cathodic protection is that of a system for introducing current into the earth from an external source, under a driving potential strong enough to overcome all of the corroding potentials of the structure. This will insure that at every point the direction of current flow will be from soil to structure.

Still a third description of cathodic protection is that of forming and maintaining on the cathode (protected structure) of a continuous hydrogen film. Such a film is evidence of complete protection, if means can be developed of indicating its presence and continuity.

From these various aspects of cathodic protection, and from experience of an empirical nature, five general criteria for protection have evolved.

The Polarization Curve

If current is supplied to a cathode in increments, starting with a small value and gradually increasing, the potential between the cathode and the electrolyte—the pipe-to-soil potential—will increase, but not uniformly. Actually, if care is taken to measure only the pipe-to-soil potential, eliminating the IR drop through the soil, it will be found that at first there is no change in potential; when a certain value of current is reached, however, the potential will increase in proportion to the logarithm of the current.

This is shown in Fig. 1, where the potential is plotted against the current, using semilog paper. The break in the curve indicates the point at which protection is just barely established. The difficulty involved in the use of this criterion is the rather complex instrumentation required to eliminate the IR drop in the soil—note that no break is seen in the uncorrected curve—and the necessity for varying the current and synchronizing readings for each point to be checked.

To determine the direction of current flow between the pipe and the soil, it is necessary to set up a pair of electrodes, one above the line, and one offset—10 ft. is a good distance—to one side. The potential difference between the two is indicative of the direction of current flow in the soil. This may, however, include some current which is merely flowing by, and not entering or leaving the line under investigation. To eliminate this effect, the measurement must be repeated with the offset electrode on the opposite side of the line. This method is not applicable where several lines are in same right-of-way.

If a long, isolated pipe line is under cathodic protection, the direction of current flow in the line itself should be at all points directed toward the drainage point. In other words, along the line between two protection units, there should be only one point of reversal of polarity. Consequently, the efficacy of the system may be determined by taking a set of adjacent line current measurements from one protective unit to another, and plotting the current values derived from them.

Careful readings must be made in the central region, where there is the greatest likelihood of finding a section not fully protected. In actual practice, it is rarely necessary to include more than the middle third of a section; if this is all under protection, the end sections are almost sure to be, unless there is some unusual condition which needs investigation.

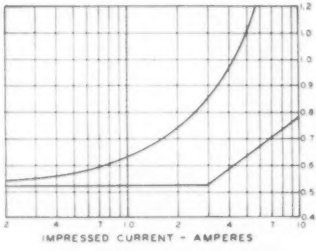


Fig. 1—Break in current-potential curve as a criterion for cathodic protection. Lower curve, pipe-to-soil potential corrected for IR drop in soil; upper curve, uncorrected potential.

Pipe-to-Soil Potential

Part 5 of this series has already discussed briefly the use of pipe-to-soil potential as a criterion of protection. The comparison of many sets of readings similar to those plotted in Fig. 1 show that almost invariably, when the break in the curve has been reached, the uncorrected curve is somewhere in the neighborhood of 0.7 to 0.8 volt—almost never above 0.85. This means that a potential of 0.85 (referred to a copper-copper sulfate electrode) will in practically every case be indicative of full protection. For this reason, and for the additional very good reason that it is a simple reading to obtain, 0.85 volt pipe-to-soil has been almost universally adopted as a criterion of protection of steel and iron structures if soil and water.

The major criticism which can be made of the use of 0.85 volt as a protection criterion is that it frequently leads to overprotection. Studies of measurements such as those in Fig. 1 indicate that the "spread" between the two curves seldom exceeds 0.3 volt at the point of the break. This means that a pipe whose natural potential is only 0.4 volt, for example, may be completely protected when this value has been shifted to a value of 0.7, which clearly requires less current than 0.85 volt.

It should be pointed out, however, that the amount of current required to change the potential by a few tenths of a volt is usually quite small, when the protection point has been reached. Consequently there will be little waste involved in insisting on 0.85 volt as a measure of protection. The use of this criterion also requires that a very extensive survey be made before the structure is placed under protection, in order to obtain values on which to base the comparison.

It is probable that the 0.85-volt criterion will continue to be the most popular, because of its safety and simplicity. When unusual or difficult cases are encountered, however, assurance of protection may often be had by careful application of one or more of the other tests.

Part 30 of a series by Marshall E. Parker, consulting engineer, Houston.

Effect of Gas Saturation on Flood Calculations

ANY calculation of flood advance based upon relative-permeability considerations should reflect a change in gas saturation of the system being flooded because the presence of gas has been shown to give a change in the relative permeabilities to oil and water. A dependence of oil and water relative permeabilities upon presence of gas was shown by Leverett in three-phase flow data.[1] Evinger et al[2] later converted these data to water-oil relative-permeability ratios, showing a dependence upon oil saturation at fixed values of water saturation, or what is equivalent, upon the amount of gas saturation. The intent of the present discussion is to show how the change in relative permeability due to the presence of gas saturation will affect the calculated relationship between water saturation at flood breakthrough and liquid viscosity ratio.

For the purposes of this calculation relative permeability curves as presented in the literature will be used.[3] This particular set of curves is chosen in preference to those of Leverett[1] because the relative permeabilities to oil and water were measured at a constant amount of gas saturation. The relative-permeability curves, showing both the flow with and without gas, are duplicated here in Fig. 1. In Figs. 2 and 3 these data of Fig. 1 have been converted to relative-permeability ratios, oil to water.

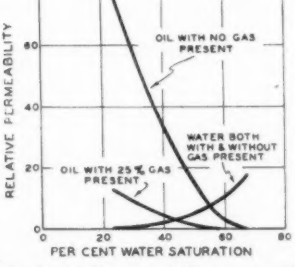

RELATIVE PERMEABILITY
OIL WITH NO GAS PRESENT
WATER BOTH WITH & WITHOUT GAS PRESENT
OIL WITH 25% GAS PRESENT
PER CENT WATER SATURATION

Fig. 1—Relative-permeability curves with and without gas.

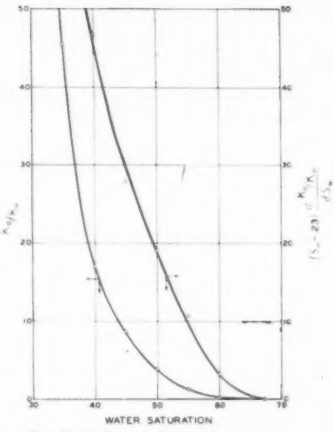


Fig. 2—k_o/k_w vs. S_w, no gas present.

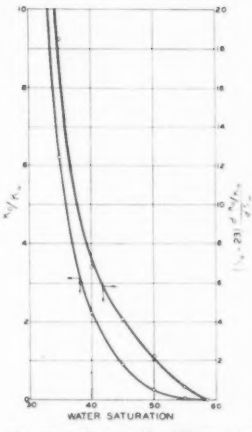


Fig. 3—k_o/k_w vs. S_w, 25 per cent gas present.

Also shown in these figures are the plots of:

$$(S_w - 0.23)\, d(k_o/k_w)/dS_w$$

The point of zero water flow shown in Fig. 1 is 0.23 and this has been taken as the connate water for this particular rock system.

These quantities are plotted for their use in the basic equations by means of which the saturation conditions at breakthrough are calculated. Details on the derivation and uses of the equations have been given in Engineering Fundamentals Nos. 457-461. The equation giving the water saturation at the flood front is:

$$\mu_o/\mu_w + k_o/k_w = (S_w - 0.23)\, d(k_o/k_w)/dS_w \quad (1)$$

and the equation for total water saturation in the system at water breakthrough is:

$$\text{Water saturation at breakthrough} = (S_w - 0.23)/f_w + 0.23 \quad (2)$$

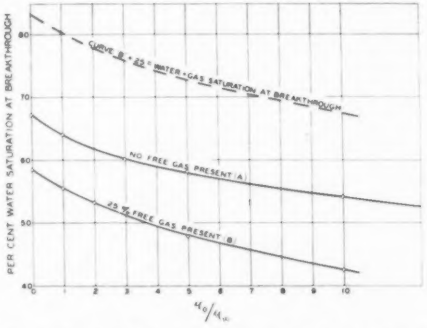

PER CENT WATER SATURATION AT BREAKTHROUGH
CURVE B = 23 - WATER-GAS SATURATION AT BREAKTHROUGH
NO FREE GAS PRESENT (A)
25 % FREE GAS PRESENT (B)
μ_o/μ_w

Fig. 4—Computed effect of free gas on water saturation at breakthrough as a function of viscosity ratio.

where S_w and f_w values in Equation 2 are taken at the flood-front water saturation calculated by Equation 1.

Fig. 4 gives the computed re-

Series by John C. Calhoun, Jr., Chairman, Petroleum Engineering School, Penn State College

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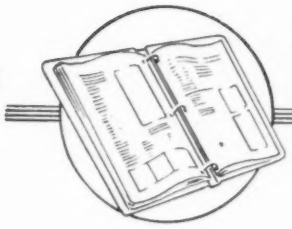
sults of Equations 1 and 2 based on the curves of Figs. 2 and 3. The water saturations at breakthrough are calculated always as being somewhat lower for the relative permeability curves where gas is present than for those curves where gas is not present. The remaining oil at breakthrough is, however, lower when gas is present because of the 25 per cent of space not occupied by either oil or water. The effect of an increase in oil viscosity on the water saturation at breakthrough seems to be more pronounced in the system where gas is present than in the system where no gas is present. Presumably, if these two curves of Fig. 4 diverged by as much as 25 per cent at higher oil viscosities, there would be no calculated benefit to the presence of gas.

The effect of a wettability change in breakthrough saturation has been calculated in Engineering Fundamentals No. 461. It was indicated that the secondary phase recovery (the difference between water saturation at breakthrough and final water saturation) was more pronounced for the oil wet system than for the water wet system. The particular relative-permeability curves used here for convenience's sake to show the effect of gas saturation are apparently for a water wet system, and the effect of the presence of gas is to change the oil relative permeability downward without affecting the water relative permeability. Hence, the effect is to lower the values of k_o/k_w. This is, in essence, the same directional change which occurs when a water wet system is converted to an oil wet system. A lowering of water saturation at breakthrough is therefore accompanied by a greater secondary phase production.

Conversely, in an oil wet system the effect of gas saturation on recovery calculations such as these would be to lower the water relative permeability but leave the oil relative permeability unchanged, and thus raise the k_o/k_w values. This should have the effect of higher water saturations at flood breakthrough and a smaller secondary phase than would exist with no gas present. This would indicate a greater benefit to gas saturation in an oil wet system than in a water wet system, but the individual relative permeability curve would have to be studied before results could be predicted.

References

1. Leverett and Lewis, Steady Flow of Gas-Oil-Water Mixtures Through Unconsolidated Sands, A.I.M.E. Trans. Vol. 142, 1941.
2. Evinger and Muskat, Productivity Factors for Oil-Gas-Water Systems, A.I.M.E. Trans. Vol. 146, 1942.
3. Holmgren and Morse, Effect of Free Gas Saturation on Oil Recovery by Water Flooding, Pet. Tech., May 1951.



THE REFINER'S notebook

No. 91

Behavior of Refractories

by Ray A. Witschey*

PART of the heat energy generated in a furnace is conducted through the refractory and lost to the surroundings by radiation and convection. Part of the heat energy is stored in the refractory. Part is radiated back into the furnace or into the process. The heat conducted through the wall is a function of the thermal conductivity of the refractory. Thermal conductivity is expressed in B.t.u. per square foot, per hour, per F., per inch thickness—generally referred to as K factor. Thermal conductivity varies with the nature of the material from which the refractory is made, the method of manufacture, physical structure (porosity), and temperature. Heat stored in a refractory is based on the weight, mean specific heat, and temperature change. Obviously, where refractories are used to retain heat, a low thermal conductivity is usually desirable. In many processing operations it is desirable that heat be readily transmitted to protect the refractory; while in other cases, where refractories are used for recuperators, it is imperative that extremely high thermal conductivity be employed. In most cases conductivity increases as temperature becomes higher.

Stressing. — As refractories are heated they expand, and when cooled contract. This effect is known as reversible thermal expansion. It introduces stresses on the refractory structure. These stresses can be compensated for by providing for adequate expansion in the structure. Refractories also exhibit a property designated as "creep" or slow flow under stress at temperatures far below the softening temperature. This property is well known in metallurgical materials, but has been studied quantitatively to a very limited degree in the refractory field. In addition to these stresses, permanent dimension changes may occur at high temperatures as indicated by the reheat behavior previously described.

Melting.—The melting behavior of fire-clay refractories can be predicted on the basis of thermal equilibrium relationships of silica and alumina. The P.C.E. value further indicates melting behavior.

In burning or firing fire-clay refractories, a certain amount of glass is developed. At low temperatures this glass serves as a bond. This glass retains its rigidity up to about 2,000 F., after which the glass loses some rigidity and begins to act as a viscous liquid. This change is slow, however, and over a wide range of temperature the viscosity of the glass is so high that for all practical purposes it acts as if it were solid. Through this range the refractory will deform only if stressed. This particular phase of heating is best studied by hot load tests. With further heating the glass becomes more fluid and the brick sags. With still further heating the glass dissolves, the solid or crystalline portion remaining until melting is complete.

Fluxing.—Fluxing is closely associated with melting behavior. The interaction of the mineral and glassy components of fire-clay refractories might in itself be termed fluxing. In general, however, fluxing refers to the chemical reaction between refractory and extraneous substances (liquid or solid).

Disintegrating. — Gases and furnace atmospheres materially affect refractory behavior. The decomposition of carbon monoxide within a refractory body into carbon dioxide and carbon when catalyzed by iron oxide is well known. The deposition of carbon thus formed often causes brick to disintegrate. The bond or strength of refractories is materially weakened, and sometimes completely destroyed, by volatile oxides of metal and many types of gaseous atmospheres.

Spalling.—This is defined as "the breaking or crushing of a refractory unit due to thermal, mechanical, or structural causes, presenting newly exposed surfaces of the residual mass."

Thermal spalling results when refractories are unable to resist the stresses induced by unequal expansion or contraction usually associated with rapid temperature changes. Resistance to thermal spalling is related to reversible thermal expansion, heat transfer, elasticity, and texture of refractory used.

Mechanical spalling results when refractories are unable to resist structural stresses imposed by application. It is often called pinch spalling. The usual causes are pinching, inadequate provision for expansion, and improper drying. Mechanical strength, toughness, and dimensional uniformity of refractory are essential.

Structural spalling is the result of alteration in the composition and or structure of a portion of the refractory. This alteration may be induced by the action of heat, or the action of slags or gases. The structure, nature of bond, degree of burning, as well as composition of refractory, are the essential properties affecting this type of refractory behavior.

*Ceramic engineer, A. P. Green Fire Brick Co. Portion of paper presented at John Zink Heating Seminar, Tulsa, 1951.

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PIPE LINES

Remote Control

Co-Op plans system for 227-mile products line

NATIONAL COOPERATIVE REFINERY ASSOCIATION is undertaking an expansion program providing two additional pump stations and facilities for complete remote control of the organization's entire 227-mile, 6-in. products line from its refinery at McPherson, Kans., to the delivery terminal at Council Bluffs, Iowa.

Design and construction for stations and installation of controls is being handled by Refinery Engineering Co., Tulsa. Work started October 1 and will be completed next spring, according to Charles H. Hohnadle, project engineer for Refinery Engineering Co.

Existing stations on the original line built in 1941 are located at McPherson and Blue Rapids, Nebr. These are equipped with horizontal electric motor-driven centrifugal pumps.

The two new booster stations, near Abilene, Kans., and Tecumseh, Nebr., will each be equipped with a 300-hp. 20-stage vertical pump. One of the features considered in selecting the vertical-type was the advantage of having one seal gland instead of two at each pump.

Teletype used.—Remote control will be by teletype operated through American Telephone & Telegraph Co. facilities. These controls will be similar to those pioneered by Shell Oil Co. at its Douglas, Ill., products-line station.

An innovation of the National Cooperative system is the provision made to enable the McPherson dispatcher to dial a shut-down station to determine whether it has been stopped only temporarily or by a cause which would require services of an attendant to remedy mechanical or electrical trouble.

The nature of the trouble will be indicated by a standard "drop annunciator" of a common type frequently used for push-button systems. The attendant locates the trouble by looking for the "drop signal."

Provision is made for the drainage of possible leakage from mechanical seals so that it would go through piping to a sump tank. In case such leakage would be excessive a ball switch would shut down the station.

No "snuffers."—No "snuffing" devices or protection against fire is provided in the control system.

An attendant station at Blue Rapids will supervise all three pump stations that are downstream from McPherson. The Abilene and Tecumseh booster stations will be located only 40 to 50 miles from Blue Rapids. At these two booster stations there will be 7-day charts which the attendants will change weekly.

The system will operate at from 1,000 to 1,500 psi. discharge pressure, regulated by air-activated throttle

Lowering-in operations during laying of Plantation Pipe Line Co.'s 707-mile project contracted by Williams Brothers Co. G. S. Connors, partner in Williams-Connors-Stanfield, has been consultant in connection with construction.

valves. The system handles eight different types of refined products in batch shipments.

Radio Permits Issued for Six Pipe-Line Operations

WASHINGTON.—Construction permits have been issued by the Federal Communications Commission for radio facilities to be used in connection with pipe-line operations. Those projects approved include:

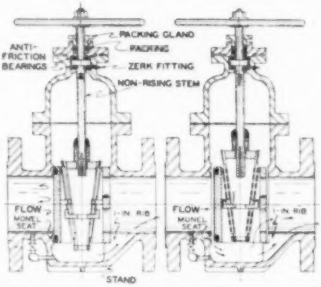
Texas Eastern Transmission Corp., two control transmitters operating on 1880, 1930, and 1980 mc. at Shreveport, and 24 relay units in groups of 3 near Minden, Holly Ridge, Farmerville, Dubach, and Hurricane, La.; and Tallula, Yazoo City, and Pickens, Miss.; Mid-Valley Pipeline Co., 12 relay transmitters on 6705 and 6805 mc. in groups of 4 near Simpsonville and Elkton, Ky., and Hornsby, Tenn.; Peoples Natural Gas Co., base station on 48.70 mc. and a control and a repeater on 74.50 or 73.22 mc. near Altoona, Pa.

United Gas Pipe Line Co., base station on 48.78 mc. and a repeater on 456.55 mc. near Houma, La.; Southern Natural Gas Co., control station on 456.45 mc. and a repeater on 457.95 mc. at Macon, Ga.; and East Tennessee Natural Gas Co., two base stations on 33.18 mc. near Theta and Signal Mountain, Hamilton County, Tennessee.

New Gate Valve

A new nonfriction gate valve of interesting design to pipe liners has been developed with the principal features of positive shutoff and frictionless operation.

Positive closing is accomplished by a metal-to-metal contact together with a synthetic-rubber ring which is forced against a seat to squeeze it into a side groove. This closure is made on the incoming-stream side so that when closed the valve body does not retain fluid.



Wheatley gate valve. (Left) Closed position: (right) first stage of opening.

In opening the valve, the first upward travel of the stem and wedge releases the disk so that upstream pressure removes disk about ⅛ in. from seat before disk commences upward travel. Wedge then engages disks as the whole assembly moves up stem. Both these features can be inserted into any conventional gate valve already in service.

Development is by Charles Wheatley Co., Tulsa, and Ohio Injector Co., Wadsworth, Ohio, has been licensed to manufacture the gate valve under Wheatley's pending patents.

Tennessee Gas Transmission Lays Loops in Kentucky

Work is under way in Kentucky on additional loops for Tennessee Gas Transmission Co., contracted by Western Pipe Line Constructors, Inc., according to J. P. Neill, president of Western.

A 10.6-mile, 30-in. loop north of Dixon, Tenn., has just been completed. Jack Hodges, spread superintendent, has moved field office to Morehead, Ky., for laying a 15-mile, 30-in. loop.

For the laying of a 53-mile, 30-in. (5/16-in. wall) loops for Tennessee Gas Transmission several weeks ago, Western double-jointed 30-ft. joints of 30-in. pipe to form 60-ft. joints.

This double-jointing was done at a

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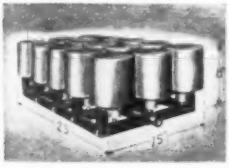

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railhead in Kentucky where automatic submerged-arc welding was applied with the use of Crutcher-Rolfs-Cummings equipment. Output of these double-jointing operations averaged 100 welds per day.

South from Richmond, Ky., a Western spread under Bennie Williams is laying 20 miles of 30-in. of 40-ft. joints which have been handled without double jointing.

United Gas Seeks to Sell Its North Texas System

SHREVEPORT.—United Gas Corp. and its subsidiaries, United Gas Pipe Line Co. and Union Producing Co., are seeking Securities and Exchange Commission approval to sell various pipe-line, producing, and distribution properties which the companies now operate in North Texas, M. A. Abernathy, vice president, announced.

Seeking to purchase the properties are Martin Wunderlich, of Omaha, and Lee Aikin, of Corpus Christi, whose acquisition of the pipe-line system will be subject to approval of the Federal Power Commission. Consideration was not disclosed.

The proposed sale covers United Gas Corp.'s natural-gas distribution systems in 17 North Texas towns. United Gas Pipe Line's gathering and transmission lines in 15 counties in Texas and Oklahoma, and Union Producing Co.'s wells, lands, and leases in Wheeler and Young counties, Texas.

United states that it desires to sell the properties because they are not connected with the main pipe-line system operated by United Gas.

Tulsa Pipe Liners' Club Elects New Officers

F. C. Whiteside, chief engineer for Continental Pipe Line Co., Ponca City, Okla., has been elected president of the Pipe Liners' Club of Tulsa for 1951-52, and will take office shortly.

Other officers elected at the September 17 meeting were: R. P. Lennart, supervisor of the oil-movements department for Service Pipe Line Co., Tulsa, vice president; D. B. Good, assistant chief engineer for Texas-Empire Pipe Line Co. and Kaw Pipe Line Co., Tulsa, secretary; and B. D. Leuty, special assistant to the manager of the crude-oil-supply and transportation division of Cities Service Oil Co., Bartlesville, Okla., treasurer.

Two new directors were elected: A. H. Newberg, chief engineer for Service Pipe Line Co., Tulsa; and J. D. Jones, assistant general superintendent of Gulf Refining Co.'s Tulsa pipe-line division. Other directors of the club are W. E. Biery, general superintendent of Mid-Continent Pipe Line Co., Tulsa, and P. L. Reichard, superintendent, Gulf Refining's Tulsa pipe-line division.

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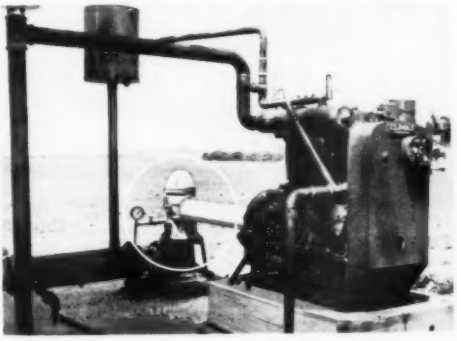

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Photo Courtesy Engine Sales and Service—Los Angeles 21

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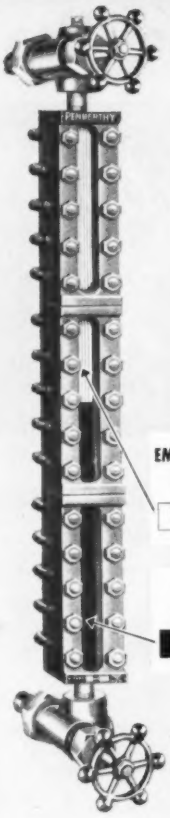

You can't misread the Penberthy Reflex Liquid Level Gage . . . *it prevents mistakes.* Due to a simple, invariable optical principle, the empty space always shows white . . . the liquid black. In addition to standard units, Penberthy Reflex Gages are fabricated to customers' specifications from special alloys to meet unusual corrosive, pressure and temperature conditions. Write for new Catalog No. 35.

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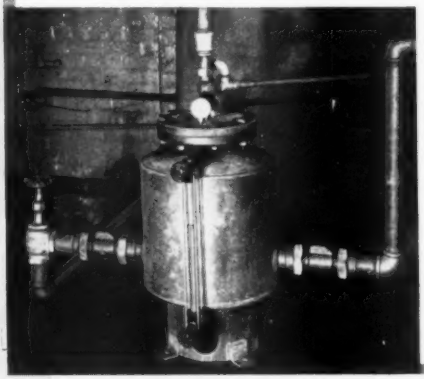

Operated by air, gas, or steam pressure, pumps (without clogging) any liquid that will flow through pipes. Lifts fluid from lower level and discharges against pressure approximately equal to operating gas pressure. Operates automatically by ejector that exhausts the vessel . . . drawing in liquid . . . then gas pressure pushes it out. Ejector and its control valve not in contact with fluid pumped. Corrosion proofing easy. Write for Bulletin 5030.

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REFINING

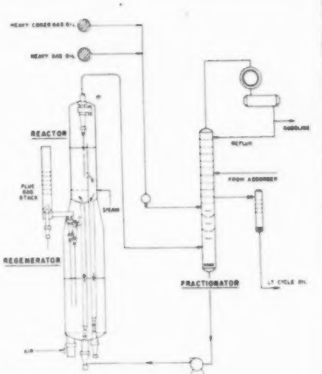
MEK Drying Discussed at Rochester A.I.Ch.E. Meet

ROCHESTER, N. Y.—A new method for drying methyl ethyl ketone was reported here last week at a meeting of the American Institute of Chemical Engineers. R. S. Mitchell of California Research Corp.'s Richmond Laboratories outlined the technique in a paper entitled "Solvent Drying."

When used for solvent dewaxing of oil, or deoiling of wax, methyl ethyl ketone often requires drying to remove water introduced with hydrocarbon feed. This cannot be done satisfactorily by distillation because of the small difference in composition of the water-methyl ethyl ketone minimum boiling azeotrope and methyl ethyl ketone saturated with water at condenser temperatures.

The author has found that the addition of benzene facilitates water removal by distillation since it induces phase separation of the overhead distillate. A ternary azeotrope exists in the methyl ethyl ketone-benzene-water system, as a minimum boiling mixture at 156° F. After condensing, this mixture separates into two phases. The upper layer comprising 91.1 weight per cent of the azeotrope, consists of 19.0 per cent MEK, 80.6 per cent benzene, and 0.4 per cent water, while the lower layer shows concentrations of 3.5 per cent MEK, 0.1 per cent benzene, and 96.4 per cent water.

Laboratory tests were conducted on a 90 per cent MEK 10 per cent benzene mixture containing small quantities of water. The author reports that it is not practical to dry methyl ethyl ketone containing from 10 to 30 per cent benzene.



ORTHOFLO PROCESS.—This diagram shows internal details of the Orthoflow fluid catalytic cracker recently put on stream at Edmonton, Alta., for British American Oil Co., Ltd., by M. W. Kellogg Co. The unit processes 2,000 bbl. daily.

Package Situation Improved

Drum production in this country is estimated currently to run about 38 per cent above the rate a year ago, easing to some extent the shortage felt by refiners for the past several months.

The lube industry is tentatively assured a supply of cans up to the 90 per cent point limit for the remainder of this year. Steel alloca-

NELSON REFINERY-CONSTRUCTION INDEX

Appears in the first issue of each month.
Explanation—Cost-imating No. 61, December 15, 1949, pages 91, 92.
Compiled by W. L. Nelson—Refinery Consultant—Tulsa.
Indexes of Individual Equipment Items—January, April, July, October.

INDEX (1946 = 100)

	1947	1948	1949	1950	June 1951
Centrifugal pumps	109.0	120.0	118.9	128.1	136.2
Reciprocating pumps	128.5	138.1	144.6	143.9	183.3
Compressor	114.0	128.0	120.0	118.8	138.1
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Motors	110.0	112.7	114.0	130.8	148.8
Transformers	116.0	116.0	116.0	116.0	130.5
Instruments	113.0	120.0	122.0	127.8	142.4
Miscellaneous equipment average	114.2	122.1	121.6	126.2	145.2
Materials component	122.4	139.3	143.6	149.5	164.2
Labor component	113.5	128.0	137.1	144.0	151.7
Refinery-construction index	117.0	132.5	139.7	146.2	156.7

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Using the DELTA-DESCO SYSTEM an operator can lubricate 10 to 15 valves in the time usually required to lubricate one with the conventional jack screw.

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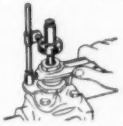

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tions to can manufacturers are said to be adequate to fill all requirements for first priority packers in military and perishable-food categories, with enough remaining to take care of lube manufacturers who fall in Class B rating allotted 90 per cent of precontrol consumption.

While can supplies appear to be easier for lube canners through 1951, there is no assurance that the industry will retain its Class B designation. Reduction to a Class C rating on a par with packers of beer and pet foods would mean that lube cans might be available in much smaller quantities. Lube manufacturers are advised to obtain supplies from current can production and to investigate all possible means for can conservation and drum reuse.

New Chemical Plant to Be Built at Texas City

TEXAS CITY, Tex.—A new chemical plant which will supply sulfuric acid to the refining and chemical processing plants here is to be built in the near future.

The new firm, Texas City Chemicals, Inc., has received a certificate of necessity for the construction and cost of the installation is believed to be several million dollars.

In addition to sulfuric acid, the plant will also manufacture dicalcium phosphate, for agricultural purposes.

Officers of the company are W. L. Pickens, Dallas, president; S. A. Winfrey, Dallas, vice president and general manager; H. A. Coffield, Rockdale, Tex., vice president and secretary-treasurer; and R. L. Wheelock, Corsicana, Tex.

New Oil Black Plant

A new $2,000,000 furnace-black plant which will produce over 30 million pounds of high-abrasion HAF-type carbon black is under construction by United Carbon Co. of Charleston, W. Va., on a site 15 miles west of the town of Franklin and near West Cote Blanche Bay in coastal Louisiana. Ford, Bacon & Davis Construction Co. has a contract for construction of the plant. Initial operation is expected for early 1952.

New Avgas Ingredient

HOUSTON.—Shell Oil Co. has developed a new aviation gasoline ingredient which is said to virtually eliminate spark plug fouling, one of the major headaches of airplane maintenance. The additive promises to be of great advantage to both civil and military aircraft, according to James H. Doolittle, Shell vice president, and the new product should cut the loss of time and money due to grounding of planes for unscheduled replacement of spark plugs.

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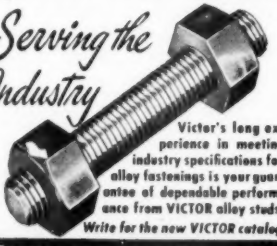

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Natural gas, propane, butane, gasoline, air, nitrogen, carbon dioxide, refrigeration compounds, all are treated with superior drying efficiency by use of FLORITE. Selectively adsorbs 4 to 20% its weight of water—is regenerated by heating to 350°F. Write for literature, names of important users in your own field.

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A recipe that waterworks and gas distribution engineers have used for over a century is: *specify cast iron pipe.* Refinery engineers have used it, too—with good success—for run-down, water and gasoline lines—for fire protection systems—salt water disposal—condenser and cooling coils.

No other pipe, at reasonable first cost, offers comparable resistance to both interior and exterior corrosion. No other pipe, in its price range, is as economical in the end. Available with bell-and-spigot, plain end and flanged, or with standardized mechanical joints. Cast Iron Pipe Research Association, Thomas F. Wolfe, Engineer, 1015 Peoples Gas Bldg., Chicago 3, Illinois.

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YOU DON'T ADMIRE SHOOTING THAT LEAVES A LOT OF CRIPPLES

It hurts to see an inept duck shooter wing a lot of his birds and leave them fluttering off to die helplessly in the reeds. But how much *more* it hurts to see outdated casing perforating methods cripple the productivity of an oil well and leave broken cement, inadequate penetration, and an unknown condition at the producing zone. That is why profit-minded well operators are now using the modern JET process originated by Welex for most of the perforating done in the U. S. today. You can use Welex Jets profitably on *every* perforating job, because Welex Jet perforating gives you *positive penetration* and provides *known hole density per foot*, with *no burrs, no fracturing*, and *no debris left in the well*. Results cost less with Welex Jets. Call your nearest Welex Station for prompt service day or night.

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Among the

Drilling Contractors

Nielson Buys Out Kirk In Cody Drilling Firm

Interests of Carroll Kirk in Kirk & Krueger Drilling Co., Cody, Wyo., have been acquired by Glenn E. Nielson, president of Husky Oil Co., also of Cody. Nielson replaces Kirk as president of the company. Carl Krueger, partner in the firm, continues as vice president and general manager, and Kenneth Lindsey as secretary-treasurer. The company name will be unchanged.

Kirk and Krueger formed their organization in 1945 and have operated in the general drilling business throughout the Rocky Mountain region since then.

Amarillo Firm Drilling In Northwest Colorado

Wagner & Wyant Drilling Co., Amarillo, Tex., has moved a rotary rig to a rank wildcat location in the Big Hole area, approximately 25 miles northeast of Craig, in Moffat County, northwestern Colorado, where it has a contract for a projected 6,000-ft. test to be drilled for Carter Oil Co. Location is in the C NW SW 23-10n-94w. Dick Hudson will be tool pusher on the job.

This contractor is operating two other rotary rigs. One currently is drilling for Carter Oil Co. in the Merino area, Logan County, northeastern Colorado, where Leonard Hudson is tool pusher. The other is working for Kansas-Nebraska Oil & Gas Co. near Lakin, Kearny County, Kansas, in the Hugoton gas field. Roy Tarrant is tool pusher on the latter rig.

Carmi Firm to Evansville

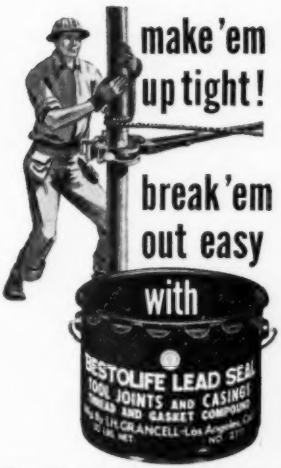
Eakle & Holder Drilling Co., formerly located at Carmi, Ill., is moving its operating headquarters to Evansville, Ind. Elmo Holder, one of the owners, already is located at Evansville. Hunter Eakle, another partner, will move about December 1. The company currently is operating three rigs, two being in the Illinois basin area, and the other in Michigan.

Transit Corp., Oklahoma City, is drilling for C. D. Edmonson and Kansas-Nebraska Natural Gas Co. at 1-E Trollstrup, E½ NW NE 3-12n-43w, 2 miles south of production in the Big Springs area, Deuel County, western Nebraska.

Can-Tex Drilling Co., Calgary, Alta., Canada, has a rig working on a new test in the Winnifred area, 25 miles southwest of Medicine Hat, southeastern Alberta Province. The test, 2 Winnifred, is being drilled for Canadian Delhi Oil, Ltd. Location is in LSD 9, 27-11-10w4.

McConnell Drilling Corp., Farmington, N. M., has a new operation under way in the Clear Creek area, Carbon County, Utah, where it is drilling

Daylight crew on a heavy-duty rotary rig which Carl B. King Drilling Co., Midland, Tex., has been operating for Penntex Oil Co. in Martin County, West Texas. Left to right: J. L. Lisenbee, F. E. Buffington, T. C. Allen, S. E. Sexton (driller), and P. L. Damico.



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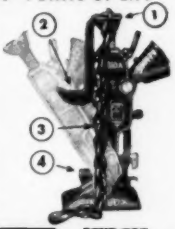
Powerful 310-A Simplex EMERGENCY JACK is easy operating, will lift vertically or push or lift in any position.

"Get the Simplex" is the call on drilling jobs when men want quick, safe jack action. The double lever socket enables them to work in close quarters and at any angle.

This 15-ton Ratchet Lowering jack will lift or lower from four points—on the rotary cap, on the auxiliary cap shoe, on the serrated toe lift, or from any intermediate height by using the chain as a sling.

4 "POINTS OF LIFT"

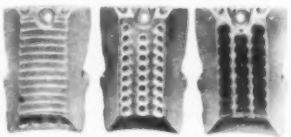


Simplex
LEVER - SCREW - HYDRAULIC
Jacks
TEMPLETON, KENLY & CO.
1034 So. Central Avenue, Chicago 44, Illinois

SEND FOR BULLETIN: Oil 48

VARCO

CASING SPIDER — AND ELEVATOR SEGMENTS WITH 'VARCO' BUTTONS



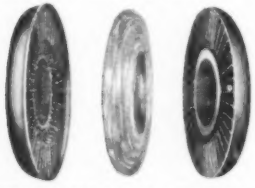
"Varco" buttons, popular for years in rotary drill pipe slips, proved satisfactory and have been adopted and are installed in segments of automatic casing spiders and elevators in various makes. Workers are removed and holes bored for a maximum number of VARCO casing buttons, to assure uniform and maximum gripping area. Low-carbon buttons for corrosive service and other coverage are available. Write for complete descriptive data.

Abegg & Reinhold Co.
2533 EAST 26TH STREET
LOS ANGELES 11, CALIFORNIA
1502 Maury St., Houston 10
418 S.E. 29th St., Oklahoma City 9
356 No. Walcott St., Casper, Wyo.
P. O. Box 748, Odessa, Texas

Ole Gyrol says-

"You can really stretch the speed range of the slush pump with adjustable speed Gyrol Fluid Drives."

Protect your investment, save time and money — Specify American Blower Gyrol Fluid Drives on your oil drilling equipment.



AMERICAN BLOWER CORP., DETROIT 32, MICH.
CANADIAN SIROCCO CO., LTD., WINDSOR, ONT.
Division of American Radiator & Standard Sanitary Corporation

Serving home and industry
AMERICAN-STANDARD • AMERICAN BLOWER
CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS
ROSS HEATER • TONAWANDA IRON

for Byrd-Frost at 1 Utah Fuel Co., NW SW SE 5-14s-7e, a projected 6,000-ft. Morrison sand test.

Barbour Drilling Co., Tulsa, is moving a rig to a wildcat location 5 miles west of Perry, Noble County, Oklahoma, where it will drill for Flynn Oil Co. at 1 Wagner, NE NE SW 23-21n-2w. Hole is projected to 5,400 ft. for a test of the Wilcox sand. Location is a mile southeast of the Sams pool.

Buffalo Drilling Co., Casper, Wyo., has the contract for a Dakota sand exploratory test which Sinclair Oil & Gas Co. is starting in the East Salt Creek area, 40 miles north of Casper, in Natrona County, Wyoming. Location is in the SE SE SW 10-36n-7ew.

El Dorado Drilling Co., El Dorado, Ark., has contracted with Lion Oil Co. for a 5,000-ft. wildcat test to be drilled in the Desha basin area, in Lincoln County, southeastern Arkansas. Location, in the SE SE NW 10-10s-8w, is 1½ miles southwest of Rest.

Scandia Drilling Co. is the contracting company on a wildcat test which Union Oil Co. of California is starting in the Ronalane area, southeastern Alberta Province, Canada. Location is for 1 Bow River.

Lyons, Prentiss & McCord, Shreveport, La., contractors will drill a Rodessa exploratory test for Isbrandt Co. of Louisiana at a location in 21-15n-11w, 3 miles southeast of Caspiana, Caddo Parish, northwestern Louisiana. Test is on the operator's Fry lease. Location is 4 miles southeast of the Caspiana gas field and about the same distance east of the Elm Grove field.

Mcutray Drilling Co. has moved a rig to a wildcat location 3 miles east of Davis, in Murray County, southern Oklahoma, where it has the contract for a test to be drilled for Anderson-Prichard Oil Corp. Location is on the latter's Myers lease in the NW SE SE 2-1s-2w.

Mose Wagner, Cut Bank, Mont., is the contractor on a Devonian test which Union Oil Co. of California is undertaking in the Cut Bank field, Glacier County, Montana. The test, located in the SW NW 19-36n-5w, on the operator's Stuffet lease, is on the northwest side of the field in an area now producing from Madison lime. It will be the first test in the field to be carried below the latter formation.

Viersen & Cochran, Inc., Okmulgee, Okla., will drill for **Mercury Drilling Co.**, Tulsa, at 1 Neitman, a wildcat test in the SE NE NE 30-17n-2e, northeastern Lincoln County, Oklahoma. Location is 3½ miles south of the Northeast Goodnight pool, across the line in Payne County.

ACTIVE ROTARY RIGS*

(United States and Western Canada)

Area	Week ended 9-24-51	Change week ended 9-17-51	Change week ended 9-25-50
Gulf Coast	592	— 3	+ 69
W. Tex.-N. M.	991	+ 19	+ 233
Ark.-N. La.-E. Tex.	163	— 10	+ 18
Oklahoma	329	+ 19	+ 61
Kansas-S. Nebraska	189	+ 25	+ 51
Illinois-Eastern	153	+ 6	+ 28
Rocky Mountains	204	+ 12	+ 81
Pacific Coast	188	+ 2	+ 45
Total United States	2,813	+ 70	+ 586
Western Canada	145	— 5	+ 41
Total	2,963	+ 65	+ 627

*Courtesy Hughes Tool Co. Trends in drilling activity in the United States and the Rocky Mountain and western Canada areas are shown on pages 374 and 375.

DERRICK ESCAPE MECHANICISM

NET WEIGHT 15 LBS.

GLIDE TO SAFETY ON GERONIMO (Patent Applied For)

GERONIMO will stand hardest wear and give unfailing protection to refinery and derrick men whose lives are endangered by fire, escaping gases or other hazards.

EASILY ATTACHED OR REMOVED
EXTRA STURDY CONSTRUCTION
QUICKLY STRADDLED
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BRONZE "No-Spark" SURFACES
RECOMMENDED FOR ½" WIRE LINE

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— MANUFACTURED BY —
CHARLIE'S MACHINE WORKS
PERRY, OKLAHOMA

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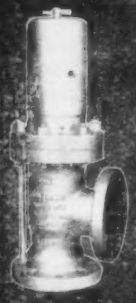
For the easiest brake known. It feeds off evenly. Standco never scores brake rims. See pages 3608-3613. Composite Catalog.

Standco Brake Lining Co.
HOUSTON

Instant Full-Open Relief of Excessive Pressures



KINZBACH MODEL 412
RELIEF VALVE

A dead weight load determines the opening pressure of the Kinzbach Model 412 Hydraulic Relief Valve . . . and when that pressure is reached, the valve opens instantly, providing full-open relief when it's needed most.
It's simple and safe—only two moving assemblies. Test rod permits functional testing at any time. Available for opening pressures from 50 to 1000 p.s.i.

KINZBACH TOOL CO., Inc.
P. O. BOX 277 • HOUSTON, TEXAS

EXPORT OFFICE:
74 Trinity Place,
New York, N. Y.

KINZBACH TOOL CO INC

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GOTT Water Coolers are the convenient way to keep drinking water handy to the worker, protect it from impurities. Their exclusive construction keeps water cool for long periods. Snug-fitting, large, removable top, handy, non-leaking, push-button faucet. GOTT Water Cans for handy field use. Your supply store has them, get one today!

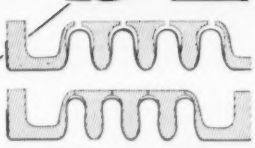
GOTKOOL WATER CAN
Made in 1½, 2, 3, 5, 10, 15 and 20 gallon sizes. Push - Button Faucet at slight additional cost.

GOTKOOL WATER COOLER
Made in 2, 3, 5, 8, 10, 15 and 20 gallon sizes with Push-Button Faucet.

KEEP PURE DRINKING WATER ALWAYS HANDY
INSIST ON THE GENUINE . . . Look for the Blue and Black Label With the Name GOTKOOL in Red.

H. P. GOTT MFG. CO.
WINFIELD, KANSAS

D-F S-E*



*EXPANSION JOINTS

The importance of D-F S-E to you may be measured in dollars. Maintenance costs are reduced to a minimum. Initial cost is amortized over a long life. Case histories show BADGER D-F S-E EXPANSION JOINTS installed in the early thirties are still on the job.

D-F S-E could mean *definite financial savings effected* actually D-F S-E does mean **Directed-Flexing Self-Equalizing.* Directed-Flexing, an exclusive construction feature in Badger Joints, is a combination of an all-curve corrugated member and correspondingly shaped Self-Equalizing rings which not only limits the movement of each corrugation but also progressively controls each increment of movement over the area of each corrugation. This construction eliminates localized stresses which cause metal fatigue and breakdowns.

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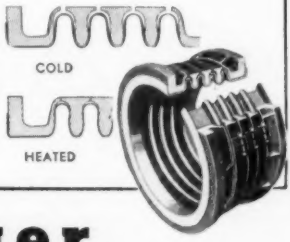
All-curve flexing guarantees longer life

Badger Joints flex like this . . .

not like this . . .

. . . this stress-free flexing principle exclusive with Badger



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MANUFACTURING COMPANY
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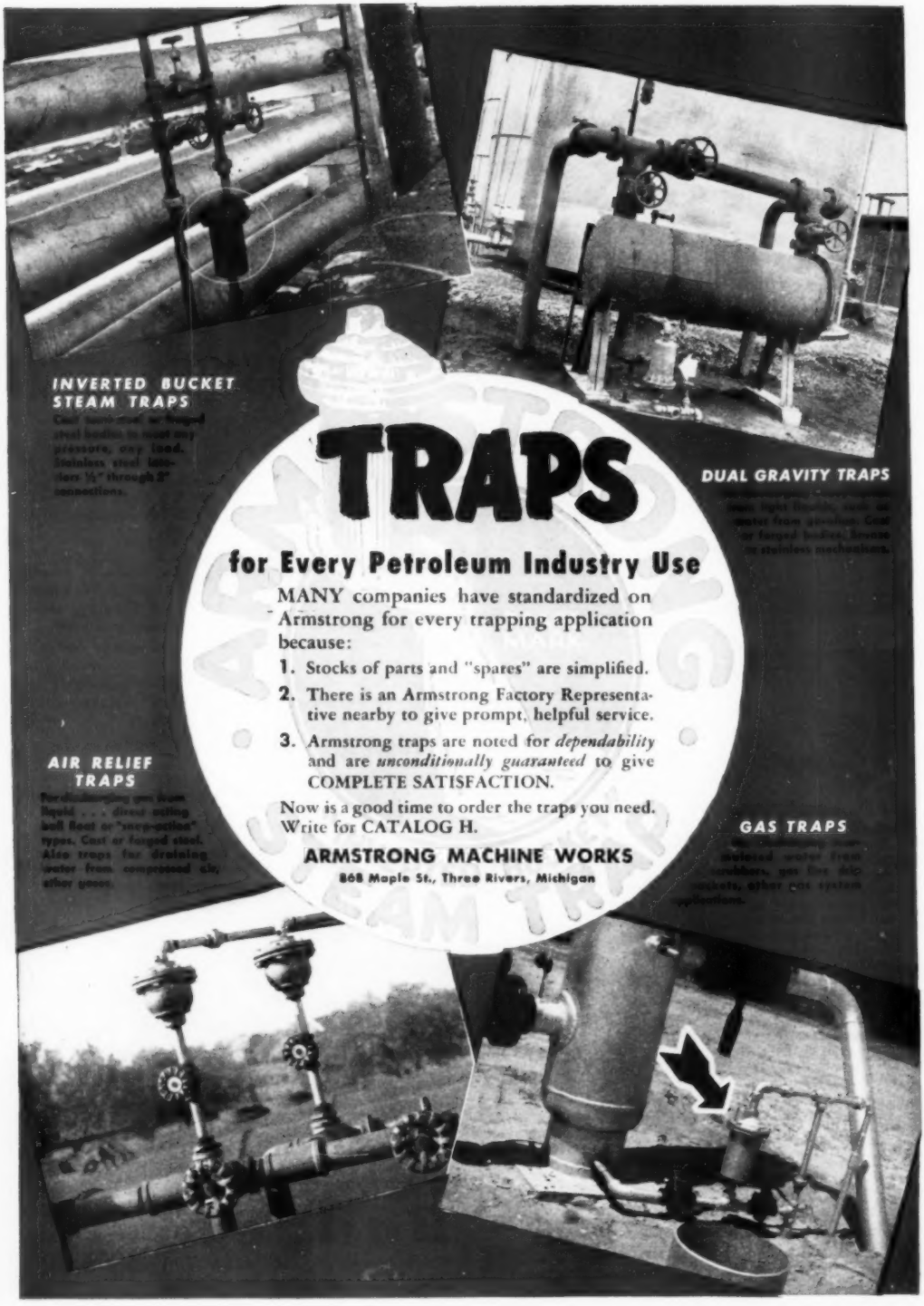
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MANY companies have standardized on Armstrong for every trapping application because:
1. Stocks of parts and "spares" are simplified.
2. There is an Armstrong Factory Representative nearby to give prompt, helpful service.
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Now is a good time to order the traps you need. Write for CATALOG H.
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AIR RELIEF TRAPS
GAS TRAPS

NATURAL GAS

Operating Revenues of Gas Companies Up 18.9 Per Cent

WASHINGTON. — Operating revenues of natural-gas companies reporting to the Federal Power Commission totaled $97,656,017 in July 1951, an increase of 18.9 per cent over July 1950 receipts of $82,108,965. For the 12 months ended July 31, 1951, revenues aggregated $1,465,720,426 or 23.8 per cent higher than the $1,184,181,998 received in the 12 months ended July 31, 1950.

Gas-utility operating income for July 1951 amounted to $9,276,581, up 1.2 per cent from the $9,164,902 reported for July of last year. For the 12 months ending July 1951, gas-utility operating income was $227,657,321, representing an increase of 13.1 per cent over the $201,323,565 reported for the comparable period ending July 1950.

Gas sales to ultimate consumers during the month were 155,982,000,000 cu. ft., an increase of 16.4 per cent over July 1950. Sales to residential and commercial consumers increased 5.9 per cent and 5.2 per cent, respectively, while those to industrial consumers increased 16.8 per cent. Revenues from sales to ultimate consumers increased 14.9 per cent and amounted to $42,580,526. Revenues from the three classes of service—residential, commercial, and industrial—increased 5.1, 5.4, and 22.1 per cent, respectively.

Net income of the companies for July 1951 was $6,073,184, down 4.6 per cent from the July 1950 net of $6,364,937. However, net income of $182,905,905 for the 12 months ending July 1951 represented an increase of 6.8 per cent over the $171,310,686 realized in the comparable period ending July 1950.

Lake Shore Decision Is Affirmed in New Order

WASHINGTON.—After a rehearing, the Federal Power Commission has affirmed its order of last February 15 authorizing Lake Shore Pipe Line Co., Cleveland, to acquire, construct, and operate pipe-line facilities to supply the northeastern Ohio area with natural gas.

Lake Shore's project, estimated to cost about $1,450,000, will include approximately 45 miles of 10¾-in. line extending from a point of interconnection with Tennessee Gas Transmission Co.'s system near Meadville, Pa., to Ashtabula, where it will connect with the 27-mile section of existing line, to be acquired from Lake Shore Gas Co.

Tennessee will supply 17,000,000 cu. ft. of gas per day to Lake Shore Pipe Line Co., which proposes to deliver and sell gas to Lake Shore Gas Co., Lake County Gas Co., the city of Painesville, and Diamond Alkali Co. at Painesville.

Commonwealth Asks Increase

RICHMOND, Va. — Commonwealth Natural Gas Corp. of this city has filed with the Federal Power Commission in Washington, D. C., for an increase in its natural-gas rates, applicable to wholesale service to five Virginia utility customers, of approximately $267,000, or 9.7 per cent.

Natural Gasoline

California Standard Is Enlarging Midway Plant

LOS ANGELES.—Standard Oil Co. of California is well under way on a program of enlarging and increasing the efficiency of its 1-C Midway natural-gasoline plant in Buena Vista field of Kern County.

The work involved includes adding a new three-cell induced-draft cooling tower, additional compressors, two 200-hp. boilers, new absorber, and added heat exchanging, preheating, and accumulating facilities.

Increased pressure-maintenance operations in 27-B pool, which the plant serves, is the cause for doubling its capacity to 40,000 M.c.f. daily. The new facilities also will result in improved recovery of iso and normal-butane fractions.

The work is being done by company personnel, at an estimated cost of $350,000. Completion is scheduled for about November 1.

Gasoline Plant to Handle Spraberry Gas Is Planned

DALLAS.—A jointly owned gasoline plant is tentatively planned to take care of the casing-head gas produced with oil in the Spraberry trend of West Texas. It is contemplated that Magnolia Petroleum Co. will construct and operate the plant to serve the Midland, Upton, Reagan, and Glasscock counties area.

Other operators interested in the project are Sinclair Oil Co., Atlantic Refining Co., Sunray Oil Corp., Stanolind Oil & Gas Co., Tide Water Associated Oil Co., Sohio Petroleum Co., Sun Oil Co., and others.

All operators in the area which will be served by the plant have been invited to participate in the project.

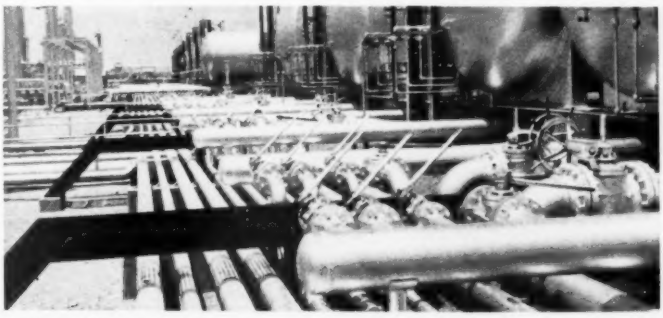
L.P.G. Shortage Possible

WASHINGTON. — Lack of high-pressure tank cars next winter may bring about a recurrence of the shortages of liquefied-petroleum gas suffered in many localities last season.

With this in mind, Interior Secretary Oscar L. Chapman has warned L.P.G. users and distributors to fill their storage tanks before the advent of cold weather.

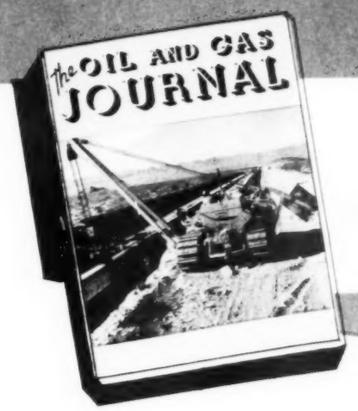
There will be no scarcity of propane or butane, Chapman said, but materials shortages have held back the expansion of transportation and storage facilities to meet the steadily increasing demand.

Petroleum Administration officials estimate that an increase of almost 50 per cent in the supply of pressure cars would be required to handle L.P.G. transportation during the 1951-52 season. There is little likelihood that an increase of this proportion can be achieved, because of steel shortages and other factors that have slowed down the production of new cars. Steel shortages also have made it impossible for distributors adequately to expand their bulk storage facilities.

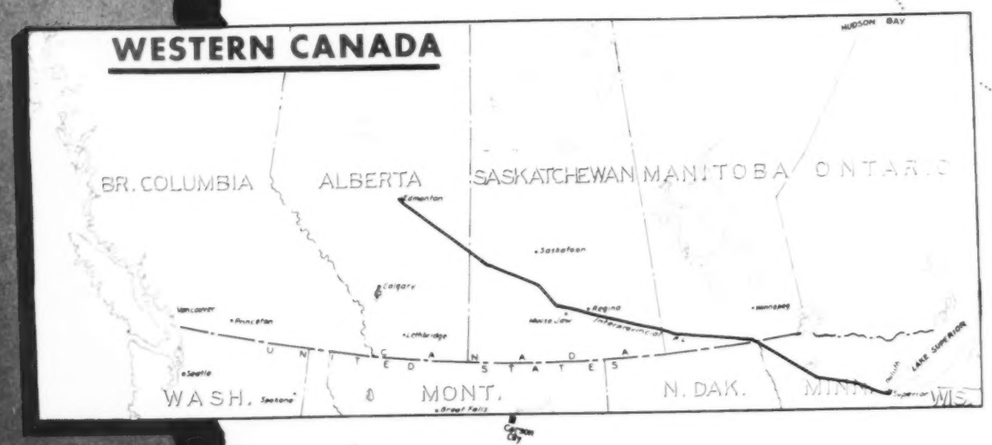


HANDY HANDLES.—Each of the plug valves in this compact manifold are equipped with individual handles despite close pipe spacing and relative location of valves. By installing the valves so that their plugs are one bolt hole off plumb, they may be opened or closed without interference from handles on adjacent valves.

Prepared by the editorial staff of The Oil and Gas Journal. Supplement to The Oil and Gas Journal, issue of October 4, 1951. Copyright, 1951, by The Petroleum Publishing Co., Tulsa, Oklahoma.



JOURNAL-GUIDE TO CRUDE OIL



REFINERY LOCATIONS AND CRUDE-OIL CAPACITIES (BARRELS DAILY)

ALABAMA (2 Plants) 9.000

American Bitumuls Co., Mobile 6.000
Hunt Oil Co., Tuscaloosa 3.000

ARKANSAS (6 Plants) 64.500

Berry Asp. Co., Stephens 1.500
Waterloo 1.000
Henry H. Crous, Smackover 6.000
Lion Oil Co., El Dorado 23.000
MacMillan Pet. Co., Morphlet 6.000
Pan Am Sou. Corp., El Dorado 20.000

CALIFORNIA (49 Plants) 1.068.900

Aromalene, Inc., Long Beach 1.000
Bell Pet. Co., Casmalia 3.500
Ben Hur Ref. Corp., Long Beach 4.700
Calasiatic Ref. Co., Long Beach (1)
Caminol Co., Ltd., Hanford 5.000
Century Oil Co., Signal Hill 3.000
Douglas Oil Co., Bakersfield 6.500
Paramount 4.000
Edgington Oil Ref., Long Beach 5.000
Emyvale Pet. Co., Long Beach 2.000
Five C Ref. Co., Santa Maria 3.500
Fletcher Oil Co., Wilmington (1)
General Pet. Corp., Lobec 23.000
Torrance 125.000
Vernon 4.000
Golden Bear Oil Co., Oildale 2.000
Hancock Oil Co., Long Beach 12.500
MacMillan Pet. Corp., Signal Hill 7.000
Richfield Ref. Co., Huntington Beach 5.500
Mohawk Pet. Corp., Bakersfield 11.500
Newhall Ref. Co., Newhall 3.000
Norris Co., Maricopa 10.000
Bakersfield 5.000
Olympic Ref. Co., Long Beach 5.500
Oxnard O. & R. Co., Oxnard 2.500
Palomar O. & R. Corp., Bakersfield 1.800
Paraffin Cos., Inc., Emeryville 1.500
Richfield Oil Corp., Watson 100.000
Rothschild Oil Co., Santa Fe Springs 13.000
Seaside Oil Co., Ventura 4.500
Shell Oil Co., Martinez 45.000
Wilmington 52.000
Socal O. & R. Co., Huntington Beach 2.000
Standard of Calif., Bakersfield 17.000
El Segundo 117.000
Richmond 136.000
Sunland Ref. Corp., Bakersfield 3.000
Sunray Oil Corp., Santa Maria 7.500
Sunset Oil Co., Los Angeles 15.000
Texas Co., Los Angeles 55.000
Tide Water Asso. Associated Oil Co., Wilmington 83.000
Triangle O. & R. Co., Venice 2.500
Union Oil Co. of Calif., Bakersfield 5.800
Oleum 28.000
Wilmington 69.000
Western Asp. & Ref. Co., Wilmington 1.500
Westoil Terminals Co., Wilmington 24.000
Wilshire Oil Co., Inc., Norwalk 12.000

COLORADO (6 Plants) 23.900

Bay Pet. Corp., Denver 6.000
Continental Oil Co., Denver 9.300
Empire Pet. Co., Denver 2.000
Oriental Ref. Co., Alamosa 1.100
Denver 5.000
Shelly Oil Co., Denver 1.500

DELAWARE (1 Plant) 3.500

Texas Co., Claymont 3.500

GEORGIA (1 Plant) 5.500

Mexican Pet. of Ga., Savannah 5.500

IDAHO (1 Plant) 3.500

Phillips Pet. Co., Pocatello 3.500

ILLINOIS (15 Plants) 440.400

Advance Ref. Co., Centralia 2.300
Ashland O. & R. Co., St. Elmo 5.000
Calumet Ref. Co., Burnham 1.200
Cross, Henry N., Colmar 1.000
Dupo Oil Ref. Co., Inc., Dupo 1.000
Globe Oil & Ref. Co., Lemont 27.000
Ohio Oil Co., Robinson 40.000
Pana Ref. Co., Pana 4.000
Petco Corp., Blue Island 20.000
Shell Oil Co., Wood River 120.000
Sinclair Ref. Co., Hartford 10.000
Socony Vacuum, E. St. Louis 20.000
Standard Oil (Ind.), Wood River 43.900
Texas Co., Lawrenceville 47.000
Lockport 60.000

INDIANA (9 Plants) 372.800

Cities Service Co., (Del.), East Chicago 35.000
Ind. Farm Bureau, Mount Vernon 10.000
Johnson Oil Supply, Gary 2.500
R. J. O. & R. Co., Princeton 6.500
Rock Island Ref. Corp., Indianapolis 10.000
Sinclair Ref. Co., East Chicago 80.000
Socony Vacuum, East Chicago 35.000
Standard Oil (Ind.), Whiting 193.000
Troy Ref. Co., Troy 1.800

KANSAS (15 Plants) 439.750

Barsco Oil Co., Wichita 7.000
Bay Pet. Corp., McPherson 6.000
Coop. Ref. Asso., Coffeyville 20.000
Phillipsburg 4.000
Derby Oil Co., Wichita 10.000
El Dorado Ref. Co., El Dorado 10.000
Kanotex Ref. Co., Arkansas City 9.000
M F A. Oil Co., Chanute 1.850
Nati. Coop., McPherson 23.000
Phillips Oil Co., Kansas City 50.000
Shallow Water Ref. Co., Garden City 2.500
Skelly Oil Co., El Dorado 35.000
Socony Vacuum, Augusta 27.000
Standard Oil Co. (Ind.), Neodesha 10.400
Vickers Pet. Co., Inc., Potwin 6.000

KENTUCKY (7 Plants) 79.000

Asina Oil Co., Louisville 10.000
Ashland O. & R. Co., Catlettsburg (1) 10.000
Catlettsburg (2) 23.000
Louisville Ref. Co., Louisville 8.000
Somerset Ref., Somerset 1.500
Standard Oil (Ohio), Latonia 18.500
Stoll Oil Ref. Co., Louisville 2.000

LOUISIANA (15 Plants) 505.850

Bayou State Oil Corp., Houston 1.000
Bay Petroleum Corp., Chalmette 12.000
Breaux Bridge O. & R. Co., Breaux Bridge 650
Calumet Ref. Co., Princeton 700
Canal Refining Co., Church Point 1.000
Cit-Con Corp., Lake Charles (1)
Cities Service Ref., Lake Charles 150.000
Continental Oil Co., Westlake 11.000
Esso Standard, Baton Rouge 145.000
Evangeline Ref. Co., Inc., Jennings 1.000
Gilcrease Oil Co., Mersaux 4.000
Pan Am. Sou. Corp., Destrehan 15.000
Petco Corp., Marrero 7.500
Shell Oil Co., Norco 50.000
Stanolind O. & G. Co., Vivian 7.000

MARYLAND (3 Plants) 67.500

Am. Bitumuls Co., Baltimore 6.000
Esso Standard, Baltimore 55.000
Pan Am. Ref. Corp., Baltimore 6.500

MASSACHUSETTS (2 Plants) 47.000

Cities Service (Pa.), E. Braintree 15.000
Esso Standard, Everett 32.000

MICHIGAN (17 Plants) 122.450

Aurora Gasoline Co., Detroit 16.000
Elsie 5.500
Bay Ref. Co., Bay City 10.500
Crystal Ref. Co., Carson City 6.200
Lakeside Ref. Co., Kalamazoo 2.300
Leonard Ref. Co., Inc., Alma 10.000
Marvel Ref. Co., Grand Rapids 2.000
Mid-West Ref., Inc., Alma 10.000
Nagh-Sol Ref. Co., Muskegon 5.250
Old Dutch Ref. Co., Muskegon 4.500
Osceola Ref. Co., Reed City 2.000
Pet Specialties, Inc., Flat Rock 6.500
Producers Refining, Inc., West Branch 3.500
Pure Oil Co., Midland 4.700
Roosevelt O. & R. Corp., Mt. Pleasant 8.000
Shamrock O. & G. Corp., Saginaw 3.500
Socony Vacuum, Trenton 22.000

MINNESOTA (2 Plants) 7.500

Northwestern Ref. Co., New Brighton 5.000
St. Paul Park 2.500

MISSISSIPPI (2 Plants) 7.500

Paluxy Asphalt Co., Crupp 3.500
Southland Oils, Sandersville 3.900

MISSOURI (1 Plant) 38.200

Standard Oil (Ind.) Sugar Creek 38.200

MONTANA (10 Plants) 59.000

Big West Oil Co., Kevin 2.000
Carter Oil Co., Billings 20.000
Continental Oil Co., Billings 6.500
Farmers Union, Laurel 12.000
Hart Ref., Missoula 600
Phillips Pet. Co., Great Falls 2.900
Soiar Oil & Ref. Co., Hardin 2.500
Texas Co., Sunburst 7.500
Union Oil of Calif., Cut Bank 3.600
Unity Petroleum Corp., Kalispell 1.000

NEBRASKA (4 Plants) 10.400

Coop. Ref. Asan., Scotts Bluff 3.200
Mid-States Ref. Co., Falls City 6.000
Seaide Pet. Co., Omaha 1.500
Sioux City Co., Chadron 700

NEW JERSEY (6 Plants) 425.000

Calif. Ref. Co., Barber 50.000
Cities Service (Pa.), Linden 15.000
Esso Standard, Linden, etc. 165.000
Socony Vacuum, Paulsboro 50.000
Texas Co., Westville 60.000
Tide Water Asso., Bayonne 77.000

NEW MEXICO (6 Plants) 16.950

Area Co., Bloomfield 300
Continental Oil Co., Artesia 2.400
Farmington 750
Famarisa O. & R. Co., Monument 600
Malco Ref., Roswell 2.500
McNutt O. & R., Brickland 3.000
New Mex. Asph. & Ref. Co., Artesia 5.000
Pat. Prod. Ref. & Prod. Co., Prewitt 1.500

NEW YORK (6 Plants) 92.500

Frontier O. & R. Co., Tonawanda 10.000
Gulf Oil Corp., Staten Island 30.000
Sinclair Ref. Co., Wellsville 9.000
Socony Vacuum, Brooklyn 22.500
Buffalo 24.000
Olean 7.000

OHIO (12 Plants) 299.100

Ashland O. & R. Co., Canton 12.000
Dewese Oil Ref., Weston 500
Gulf Refining Co., Cleves 30.000
Toledo 40.000
National Refining Co., Findlay 9.500
Pure Oil Co., Newark 15.500
Toledo 23.400
Standard Oil (Ohio), Cleveland 42.500
Toledo 31.000
Lima 30.500
Sun Oil Co., Toledo 50.000
Western Res. Ref. Co., Miles 2.200

OKLAHOMA (22 Plants) 314.000

Allied Materials, Stroud 2.000
Anderson-Prichard, Cyril 10.000
Bell Oil & Gas Co., Grandfield 7.000
Ben Franklin Ref. Co., Ardmore 7.500
Champlin Ref. Co., Enid 28.000
Cities Service (Del.), Ponca City 13.000
Continental Oil Co., Ponca City 32.500
Deep Rock Oil Corp., Cushing 18.000
Johnson Oil Ref. Co., Cleveland 6.000
Kerr-McGee Oil, Inc., Wynnewood 9.000
Mercury Oil Ref. Co., Okla. City 5.000
Mid-Cont. Pet. Corp., W. Tulsa 50.000
Midland Coop., Cushing 6.500
Monarch Ref., Inc., Oklahoma City 1.000
Peppers Ref. Co., Oklahoma City 1.500
Phillips Oil Co., Okmulgee 8.000
Sunray Oil Corp., Duncan 25.000
Allen 10.000
Beckett 10.000
Texas Co., West Tulsa 35.000
Tide Water Assoc., Drumright 12.000
Wilcox Oil Co., Bristow 5.000

OREGON (1 Plant) 3.500

California Asp. Corp., Portland 3.500

PENNSYLVANIA (17 Plants) 512.900

Atlantic Ref. Co., Philadelphia 117.000
Cities Service (Pa.), Titusville 3.000
Freedom-Valvoline, Freedom 4.000
Gulf Oil Corp., Neville Island 14.000
Philadelphia 107.000
Kendall Ref. Co., Bradford 3.000
Pennsylvania Ref. Co., Karns City 1.400
Penzoil Co., Rouseville 8.500
Quaker State, Bradford 4.200
Emlenton 2.000
Oil City 2.800
Sinclair Ref. Co., Marcus Hook 90.000
Somerset Ref. Co., Somerset 2.000
Petrolia 4.000
Sun Oil Co., Marcus Hook 140.000
United Ref. Co., Warren 5.500
Wolf's Head Oil Ref. Co., Reno 3.500

RHODE ISLAND (2 Plants) 13.000

Am. Bitumuls Co., E. Providence 1.500
Socony-Vacuum, E. Providence 8.500
Texas Co., Providence 3.500

SOUTH CAROLINA (1 Plant) 7.500

Esso Standard, Charleston 7.500

SOUTH DAKOTA (2 Plants) 330

Hot Springs Ref. Co., Hot Springs 200
How Kola Ref. Corp., Sturgis 130

TENNESSEE (2 Plants) 5.200

Delta Ref. Co., Memphis 4.200
Southern Oil Service, Nashville 1.000

TEXAS (65 Plants) 1.984.050

Am. Liberty Oil Co., Mt. Pleasant 14.000
Atlantic Ref. Co., Port Arthur 50.000
Col-Tex Ref. Co., Colorado City 12.000
Consumers Coop., Levelland 9.500
Continental Oil Co., Wichita Falls 7.000
Coaden Pet. Corp., Big Spring 17.000
Crown Central Pet. Corp., Houston 28.000
Danaho Ref. Co., Petrus 4.000
Dodds Ref. Co., Jacksonville 1.000
Eastern States Pet. Co., Houston 37.500
Eddy Ref. Co., Houston 2.000
Gladewater Ref. Co., Gladewater 2.500
Great Sou. Corp., Corpus Christi (1)
Gulf Oil Corp., Fort Worth 9.500
Port Arthur 230.000
Sweetwater 8.000
Humble O. & R. Co., Baytown 315.000
Inland Ref. Co., Inc., Palestine 2.000
Lacy, R., Inc., Big Sandy 3.500
LaSalle Pet. Corp., Burkburnett 1.500
Magnolia Pet. Co., Beaumont 150.000
Fort Worth 12.000
Marathon Oil Co., Houston 5.000
McBride Ref. Co., La Blanca 2.500
McMurrey Ref. Co., Tyler 9.000
Mex-Tex Oil Co., Rio Grande City 200
Monarch Ref. Co., San Antonio 1.200
Onyx Ref. Co., Abilene 5.500
Pan-Am. Ref. Corp., Texas City 114.000
Panhandle P. & R. Co., Wichita Falls 5.800
Patton Oil Co., Rotan 1.500
Peerless Tank Cl. Co., Kilgore 1.000
Petroleum Products R. & P. Co., Leuders 1.500
Petrolite Corp., Kilgore 700
Phillips Oil Co., Borger 56.000
Sweeny 65.000
Pontiac Ref. Corp., Corpus Christi 20.000
Premier Pet. Co., Arp 5.000
Baird 2.500
Longview 4.000
Fort Worth 6.500
Pure Oil Co., Nederland 55.000
Rado Ref. Co., McAllen 2.000
Republic Oil Ref. Co., Texas City 30.000
Shamrock O. & G. Corp., Sunray 10.000
Shell Oil Co., Deed Park (Houston) 115.000
Sid Richardson Ref. Co., Texas City 35.000
Sinclair Ref. Co., Corpus Christi 18.000
Houston 90.000
Skelly Oil Co., Longview 5.000
Southwestern O. & R. Co., Corpus Christi 30.000
Standard Oil of Texas, El Paso 18.000
Taylor Ref. Co., Corpus Christi 42.500
Port Isabel 10.000
Texas City Refining, Inc., Texas City 60.000
Texas Co., Amarillo 8.500
El Paso 5.500
Port Arthur 150.000
Port Neches 40.000
Three Rivers Ref., Three Rivers 1.500
Tydal Co., Gainesville 2.000
Ute Oil & Ref. Co., Graham 650
W. T. Waggoner Estate, Vernon 5.000
Wickett Ref. Co., Wickett 9.000
Winnsboro Refining Co., Winnsboro 4.000

UTAH (5 Plants) 59.450

Phillips Pet. Co., Woods Cross 4.200
Salt Lake Ref. Co., North Salt Lake 27.000
Utnta Oil Ref. Co., Vernal 1.250
Utah Oil Ref. Co., Salt Lake City 23.500
West States Ref. Co., W. Salt Lake 3.500

WASHINGTON (2 Plants) 8.500

Phillips Pet. Co., Spokane 5.000
Stanocal Asp. & Bitu. Co., Richmond Beach 3.500

WEST VIRGINIA (4 Plants) 15.000

Carbide Carb. Chem. Co., Charleston 2.500
Elk Ref. Co., Falling Rock 4.500
Pure Oil Co., Cabin Creek 5.500
Quaker State, St. Marys 2.500

WISCONSIN (2 Plants) 5.500

Lake Superior Refining Co., Superior 4.000
Wisconsin Oil Ref. Co., Sheboygan 1.500

WYOMING (14 Plants) 95.260

C. & H. Refinery, Lusk (a)
Continental Oil Co., Glenrock 3.400
Coop. Ref. Asan., Newcastle 1.000
Empire State Oil Co., Thermopolis 1.500
Frontier Ref. Co., Cheyenne 10.000
Husky Ref. Co., Cody 5.000
Ohio Oil Co., Lovell 8.000
Resolute Oil Corp., Badger Basin 1.000
Sinclair Ref. Co., Sinclair 35.000
Sioux Oil Co., Newcastle 2.500
Socony Vacuum, Casper 8.500
Standard Oil (Ind.), Casper 15.000
Texas Co., Caipel 500
Casper 14.000

Product Lines
Crude-Oil Lines
Refineries

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Each pipe-line system is shown continuously in the same color, fro
all destinations. This facilitates "following through" each system. A
overlapping lines of other systems are shown in a different color, fo
reason of ease of tracing or following through.

L; PRODUCT PIPE LINES

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LAKE SUPERIOR

LAKE MICHIGAN

LAKE HURON

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Washington D.C.

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CRUDE OIL

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American Petroleum Co.
Arkansas Pipe Line Co.
Atlantic Pipe Line Co.
Basin Pipe Line System
Bell Oil & Gas Co.
Buckeye Pipe Line Co.
Canadian Trunk Line
Champlin Refining Co.
Cities Service Pipe Line Co.
Continental Pipe Line Co.
Deep Rock Oil Corp.
Derby Oil Co.
Empire Pipeline Co.
Eureka Pipe Line Co.
General Petroleum Corp.
Gulf Refining Co.
Houston Pipe Line Co.
Humble Pipe Line Co.
Interstate Oil Pipe Line Co.
Johnson Oil Refining Co.
Kaw Pipe Line Co.
Leonard Pipe Line Co.
Lion Oil Co.
Magnolia Pipe Line Co.
Mid-Continent Pipe Line Co.
Mid-Valley Pipe Line Co.
National Transit Co.
New York Transit Co.
Northern Pipe Line Co.
Ohio Oil Co.
Ozark Pipe Line System
Pan American Pipe Line Co.
Panoztex Pipe Line Co.
Phillips Pipe Line Co.
Platte Pipe Line Co.

Phillips Pipe Line Co.
Platte Pipe Line Co.
Portland Pipe Line Co.
Pure Transportation Co.
Rancho Pipe Line Co.
Richfield Oil Corp.
Rocky Mountain Pipe Line Co.
Salt Lake Pipe Line Co.
Service Pipe Line Co.
Shell Pipe Line Corp.
Simrall Corp.
Sinclair Refining Co.
Skelly Oil Co.
Socony-Vacuum Oil Co., Inc.
Sohio Pipe Line Co.
Sohio Petroleum Co.
Sohio Western Pipe Lines, Inc.
Sohio Southern Pipe Lines, Inc.
Southern Pipe Line Corp.
Southwest Pennsylvania Pipe Lines
Standard Oil Co. of California
Sun Pipe Line Co.
Texas-Empire Pipe Line Co.
Texas-New Mexico Pipe Line Co.
Texas Pipe Line Co.
Tide Water Associated Oil Co.
Tide Water Pipe Co., Ltd.
Toronto Pipe Line Co.
Transit & Storage Co.
Valley Pipe Line Co.
Valvoline Pipe Lines
Union Oil Co. of California
Utah Oil Refining Co.
West Texas Gulf Pipe Line Corp.
Wilcox Oil Co.
Yount-Lee Pipe Line Co.

PRODUCTS

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Detroit Southern Pipe Line Co.
Essaness Corp.
Esso Standard Oil Co.
Great Lakes Pipe Line Co.
Humble Pipe Line Co.
Keystone Pipe Line Co.
Magnolia Pipe Line Co.
Miami Valley Corp.
National Cooperative Refinery Assn.
Phillips Petroleum Co.
Plantation Pipe Line Co.
Project Five Pipe Line Corp.
Richfield Oil Corp.
Shell Products Pipe Line Co.
Sinclair Refining Co.
Socony-Vacuum Oil Co., Inc.
Southeastern Pipe Line Co., Inc.
Standard Oil Co. (Indiana)
Standard Oil Co. (Ohio)
Sunray Oil Corp.
Susquehanna Pipe Line Co.
Texas Pipe Line Co.
Triangle Pipe Line Co.
Tuscarora Oil Co., Ltd.

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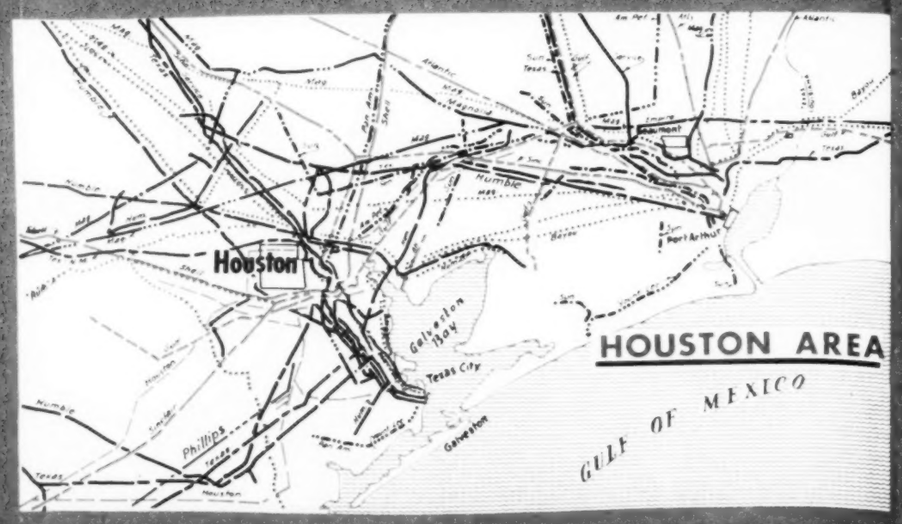

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TULSA AREA

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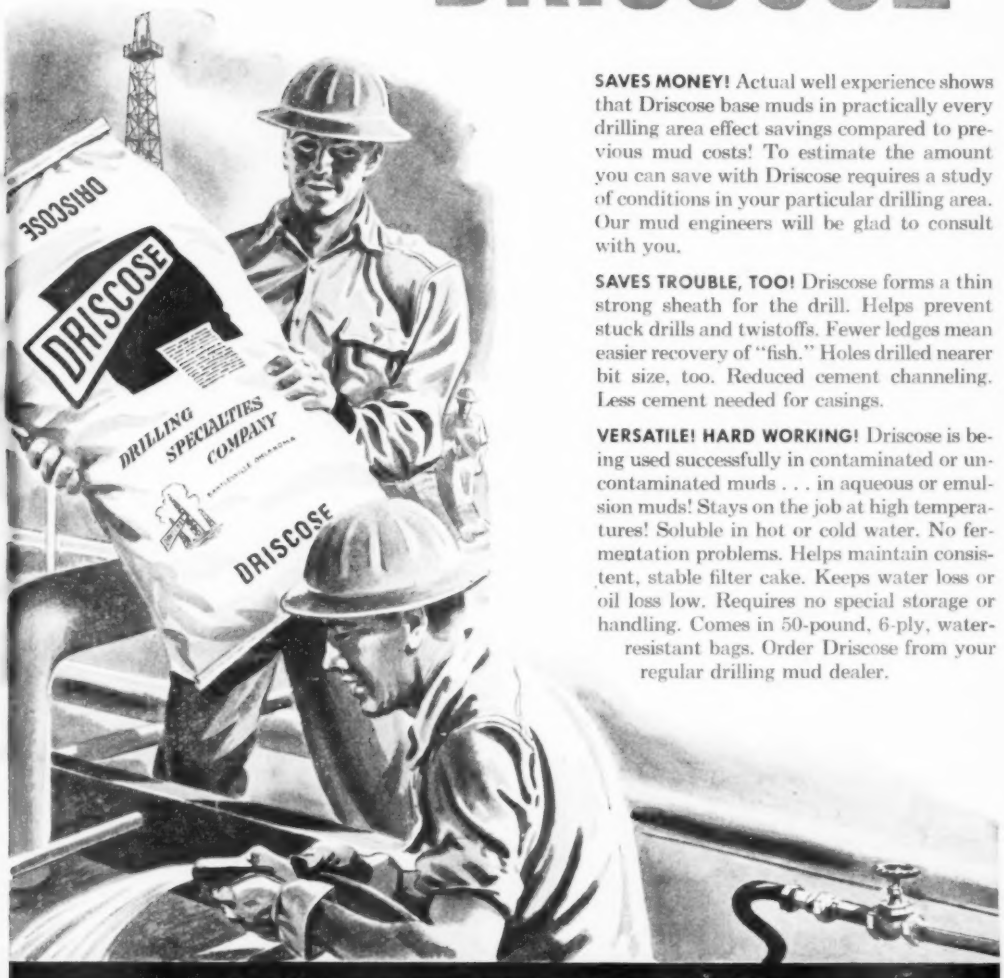

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SAVES TROUBLE, TOO! Driscose forms a thin strong sheath for the drill. Helps prevent stuck drills and twistoffs. Fewer ledges mean easier recovery of "fish." Holes drilled nearer bit size, too. Reduced cement channeling. Less cement needed for casings.

VERSATILE! HARD WORKING! Driscose is being used successfully in contaminated or uncontaminated muds . . . in aqueous or emulsion muds! Stays on the job at high temperatures! Soluble in hot or cold water. No fermentation problems. Helps maintain consistent, stable filter cake. Keeps water loss or oil loss low. Requires no special storage or handling. Comes in 50-pound, 6-ply, water-resistant bags. Order Driscose from your regular drilling mud dealer.

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DRILLING SPECIALTIES COMPANY

BARTLESVILLE, OKLAHOMA

Don't Sell Northeast Texas Short

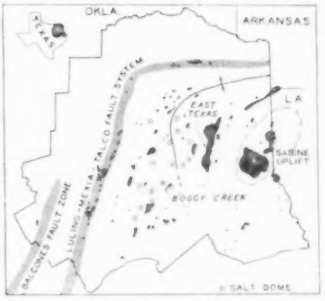
NORTHEAST Texas is no longer generally looked upon as offering many inviting prospects that might be developed into significant oil fields, but that's only because interest has been attracted to lesser-developed, greener pastures across the fence.

In this area, site of East Texas, the largest field yet proved in this country, there has been little development in recent years, certainly nothing to attract the nation-wide interest that it enjoyed between 10 and 20 years ago. Wildcats are still being drilled to Cretaceous objectives, but the area's wildcat success ratio is low by Texas standards. So far this year close to 95 per cent of the wildcats in Northeast Texas have been dry against something under 80 per cent for the remainder of Texas.

Though there hasn't been a significant oil pool discovered in Northeast Texas since the early forties, the East Texas basin has more to offer than meets the casual eye. Within the limits of the map on this page, grouped about the axis of the basin, 16 shallow, piercement-type salt domes are known. At only one field, Boggy Creek, discovered in 1925 by Humble Oil & Refining Co. to indicate the potentialities of the area away from the fault trends to the west, can production be directly related to movement of flank beds on a dome. The other domes have been but feebly tested by Gulf Coast standards.

Of all the features favoring the accumulation of oil, salt domes are unquestionably the trickiest to figure out for developing production. The history of salt-dome production development has often been long and discouraging. Gulf Coast geologists have learned and are learning a great deal about solving salt-dome problems and the day will come when what these geologists have learned will be applied to the inland domes of Northeast Texas and this old oil country will once again attract excited attention.

The Jurassic-Smackover, a big producer in Louisiana and Arkansas, is believed to cross the East Texas embayment. It has not been tested out in the basin. It could still be a porous lime as it is to the east, or it could have graded into shale. It could be uplifted to reasonable drilling



depths by the salt domes mentioned above or by others yet to be found. It could yield oil fields. It should not be neglected.

The Bureau of Economic Geology, University of Texas, is compiling for publication a series of volumes designed to present as many of the essential data pertaining to known occurrences of oil and gas in Texas as practicable in a form that is conveniently usable. The first volume, The Occurrence of Oil and Gas in Northeast Texas, has been published recently in cooperation with the East Texas Geological Society.

This volume is not a tombstone for Northeast Texas, it is a mile-tone. Here's what's been learned to date—what can you do with it? Through its well-organized reservoir data, its bountiful maps and cross-sections, its field descriptions and history, and its logs and type sections, runs a challenge to those responsible for finding and producing oil and gas. It's for those men who want to know more about the conditions of nature at the places where oil and gas have been found and produced.

In this volume is a paper on every commercial occurrence of oil and/or gas discovered in Northeast Texas prior to January 25, 1950—135 fields (many with multiple reservoirs). The publishers do not claim finality, but invite additional information.

Oil has been found in Northeast Texas in just about every recognized type of trap. There's more oil to be found in Cretaceous rocks, in deeper rocks, and around the salt domes. Don't sell Northeast Texas short.

Philip C. Ingalls.

HIGHLIGHTS OF WEEK'S DEVELOPMENTS

ROCKY MOUNTAIN AREA.—Ohio Oil Co. recovered oil on drill-stem test at its eighth apparent discovery (1 Runge) in Cheyenne County, Nebraska. Morton & Sons 1 Rauner recovered oil in a new area for the Denver-Julesburg Basin—Laramie County, Wyoming. Staining has been logged in two Big Horn Basin, Wyoming, wildcats: Stanolind Oil & Gas Co. 1 Pepper, Big Horn County, and Seaboard Oil Co. 1 State, Park County.

SOUTH LOUISIANA.—A major west extension to Westwego field, Jefferson Parish, has been completed at Stanolind Oil & Gas Co. 1 Missouri Pacific Railroad, 29-13s-23e. Through perforations at 9,076-90 ft., the well flowed 134 bbl. of 35.5 -gravity oil daily.

WEST TEXAS.—Seven miles west of the nearest Spraberry production, and 1 mile south of a Wolfcamp strike, in Reagan County Atlantic Refining Co. 1-B Sugg flowed 77 bbl. of oil in 8 hours from the Spraberry at 5,495-5,550 ft.

OKLAHOMA.—A rank wildcat in northeast Beckham County is making a gas-distillate producer. United Carbon Co. and Union Producing Co. 1 Clark Unit, C NE NW 32-12n-21w, flowed 3,000,000-4,000,000 cu. ft. of gas plus 114 bbl. of distillate from the Deese. Perforations were effected from 12,720-14,600 ft. Current depth of the test is 14,661 ft.

FOSTER FLOW TUBE*

(Gentile Patents)

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Take a good look at the picture of the Foster Flow Tube. Note how short it is in relation to the throat diameter—how a 12 inch Flow Tube is hardly more than 18 inches long. This is about maximum ratio for 3" sizes and larger. In high main line velocities (above 10'/sec. for liquids), tubes are less than one diameter in length.

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Coupled with this simplicity of installation is an accuracy comparable in all cases to that of the conventional primary devices; in many cases, a greater accuracy. Foster Flow Tubes are available in all commercial pipe sizes. Write for details and tell us about your processing and installation requirements.

*A Proved Flow Tube Added to Foster Line of Regulating Valves

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Oklahoma

Beckham County Wildcat Flows Gas and Distillate

UNITED CARBON CO. and Union Producing Co. are making a gas-distillate producer at their 1 Clark Unit, C NE NW 32-12n-21w, deep wildcat test in the northeast corner of Beckham County, in the western part of the state. During a late production test, the well flowed between 3,000,000 and 4,000,000 cu. ft. of gas with 114 bbl. of distillate in 24 hours through ¾-in. choke on the 2-in. tubing. Flowing pressure on the tubing varied from 300 to 500 psi.

Production is from the Deese section, opposite which pipe is perforated one hole per foot from a depth of 14,600 ft. up to 12,720 ft., a total of 1,880 ft. of section being taken in. Pipe in the hole consists of 7-in. casing, cemented at 11,840 ft., with 5-in. liner cemented on bottom at a total depth of 14,661 ft. Tubing was run to 14,540 ft. with packer at 11,835 ft. The Deese section through which pipe is perforated consists of sands and shales. Staining and porosity were logged at intervals through the section but no drill-stem tests were made below the bottom of the 7-in. casing.

Whatever production is coming from a depth below 13,250 ft. is the deepest in Oklahoma. The latter depth is that of the lowest perforations in the state's previous deepest producer, a well in the Northeast Bradley pool, Grady County. Location of the new well is about 6 miles northwest of Elk City and about 9 miles north of nearest production in the Elk City field. The latter field produces from the Hoxbar conglomerate section, a stratigraphically higher zone in the Pennsylvanian than the Deese.

Sinclair Oil & Gas Co. 1 Community Travis-Sanders, NW SE NW 5-7s-1w, deep wildcat test southeast of the Stockton pool, near the Pike townsite, Love County, in the extreme southern part of the state, swabbed 28¾ bbl. of 33°-gravity oil in 12 hours on a late report. Production has been increasing steadily with testing continuing. Production is from the "Birdseye" lime zone, opposite which casing is perforated at 9,200-30 ft. Hole was drilled to 9,414 ft. but has been plugged back to 9,282 ft. Casing was run to 9,335 ft. The well also is a potential producer in the lower Deese sand, in which a drill-stem test at 7,272-7,319 ft. recovered oil.

Coal Oil & Gas Co. 2 Pope, C NE NW 34-1n-9e, second Oil Creek sand well for the Oconee field, Coal County, is reported unofficially to have flowed at the rate of 35 bbl. of oil per hour through ¼-in. choke. Total depth is reported to be 7,448 ft. The new well is a southwest diagonal offset to the discovery well, 1 Styron, C SW SE 27-1n-9e, completed earlier this year by the same company. In the meantime, the company's 1 Allen, ½ mile west of the discovery well in the C SW SW 27, has reached the pay zone and is running casing with total depth at approximately 7,460 ft. It is reported to have flowed at the rate of 50 bbl. of oil per hour on a drill-stem test.

Sunray Oil Corp. has a promising Hunton lime discovery at its 1 State, NW SE SE 16-8n-2e, 5 miles southwest of Tecumseh, in western Pottawatomie County. The lime was topped at 5,191 ft. A 60-minute drill-stem test with bottom of the hole at 5,210 ft. got a good gas blow within 4½ minutes and filled 4,747 ft. of 25° oil. Flow pressure was 1,610 ft. with hole cored to 5,238 ft., and taking in the interval below 5,211 ft., another drill-stem test was made, getting 554 ft. of oil in 30 minutes. A later drill-stem test, open 1 hour, at 5,242-82 ft., yielded 75 ft. of slightly oil and gas-cut mud.

A new Skinner sand pool is being opened by Flynn Oil Co. at its 1 Wiley, SE SE NE 24-13n-2e, 7 miles south of Wellston, Lincoln County, which swabbed 5 bbl. of oil per hour while testing open hole in that

Are you turning in all your SCRAP?

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IF you are a steel user, this important job of getting more scrap back to the mills is directly up to *you*. You just cannot afford to sit idly by while the scrap shortage gets worse. For unless everyone really pitches into this job of digging out all the scrap possible, steel production is bound to suffer, and every steel user, in more or less degree, will suffer too.

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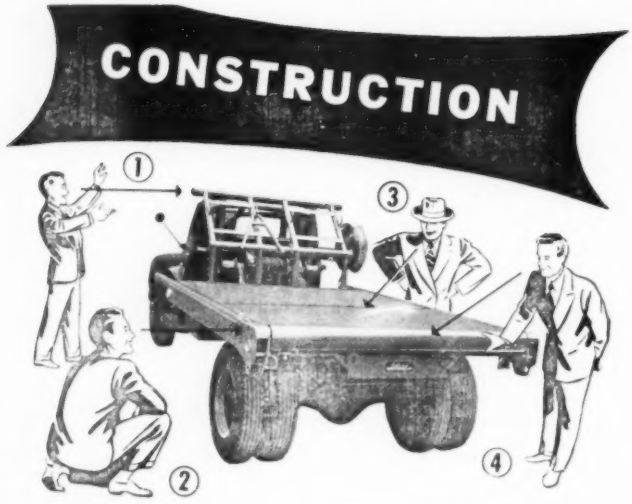

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pay at 4,780-88 ft. The discovery is 3 miles southwest of Happy Hill pool.

OKLAHOMA SUCCESSFUL WILDCATS

Pawnee County: Big Four Petroleum 1 Hattie Sinclair, SW NW SW 34-20n-8e, flowed 11 bbl. 38°-gravity oil from Bartlesville sand at 2,405-2,505 ft., TD.

Stephens County: Sinclair 1 Avis Armstrong, NW SW NW 2-2s-4w, pumped 122 bbl. 23°-gravity oil from Humphrey sand (Stringer) topped at 6,250 ft., TD 7,770 ft., new pay in Velma.

OKLAHOMA WILDCAT FAILURES

Cleveland County: Sellers 1 Sellers, NW SE NE 15-8n-1e, dry, TD 6,685 ft.

Cotton County: Sharp et al 1 Graham, NW NW NW 29-3s-10w, dry, TD 1,531 ft.

Grant County: The Texas Co. 1 Shepherd, SW SE NE 28-29n-4w, dry, TD 5,445 ft.

Jefferson County: Johnson et al 1 Faulkner, NE SW NW 11-4s-4w, dry, TD 3,650 ft.

Kay County: Falcon-Seaboard 1 McComas, NW SW NE 23-26n-1w, dry, TD 4,254 ft.

Morgan 1 Miller, NE SW NW 28-26n-1w, dry, TD 3,670 ft.

Kingfisher County: Allied Materials et al 1 Hobbs, C NW NE 20-18n-7w, dry, TD 8,424 ft.

Lincoln County: Davis et al 1 Anderson, SE SE NE 8-15n-5e, dry, TD 4,440 ft.

Noble County: Skiles Oil 1 Brorsen "B," NW SW NE 5-21n-1e, dry, TD 5,016 ft.

Howell & Howell 1 Morris "A," SW NE NE 18-24n-1e, dry, TD 4,562 ft.

Pottawatomie County: Hill, Elliott & Lamb 1 Dierker, NE NE SE 27-8n-2e, dry, TD 4,715 ft.

South Louisiana

Stanolind Extends Westwego Field

NEW ORLEANS.—Stanolind Oil & Gas Co. has completed a major west extension to Westwego field, Jefferson Parish, at 1 Missouri Pacific Railroad, 29-13s-23e. Through casing perforations at 9,076-90 ft., the well flowed 134 bbl. of 35.5°-gravity oil daily through ¼-in. choke. Tubing registered 2,300 psi. The hole was drilled to total depth of 10,353 ft. and plugged back to 9,776 ft. Operator set 7-in. production string to 9,364 ft.

A new gas-condensate discovery in Cameron Parish is indicated at Pan American Production Co. 1 Miami Corp., 4-15s-3w, wildcat located 2½ miles southeast of Pecan Lake field. Operator perforated at 12,362-77 ft. and the well flowed gas and condensate through ¼-in. choke. Tubing pressure was 3,000 psi. Testing will continue on the well, which is now bottomed at 12,706 ft.

Also in Cameron Parish, Magnolia Petroleum Co. 1 State Lease 1119, 12-15s-11w, in the West Cameron area, is preparing to perforate for production tests. It was drilled to total depth of 11,264 ft. and plugged back to 11,225 ft. Operator set 7-in. casing to 10,105 ft.

Two Beauregard Parish wildcats are now below 12,000 ft. and one is running casing. The Texas Co. 1 Isabel Crawford Logan, 4-3s-10w, is bottomed at 12,505 ft. and operator is running 7-in. casing. Magnolia 1 Magnolia Four C Unit, 32-3s-9w, is drilling in shale below 12,345 ft.

In North Hurricane Creek field, Beauregard Parish, where Magnolia opened a new deep Wilcox sand, the company has two deep wells apparently searching for the same pay. The I-A Doornbos-McPherson, 23-3s-8w, was drilled to 14,656 ft. and plugged back to 14,620 ft., and operator is preparing to perforate for testing. The other well, 1-C Ragley Lumber Co., 24-3s-8w, is drilling below 15,100 ft.

SOUTH LOUISIANA WILDCAT FAILURES

Acadia Parish: Hagen-Litchfield 1 Fannie Lou Stanford, 5-7s-1w, dry, TD 8,502 ft.

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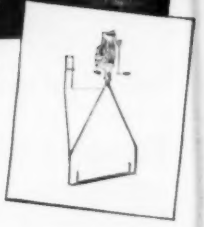

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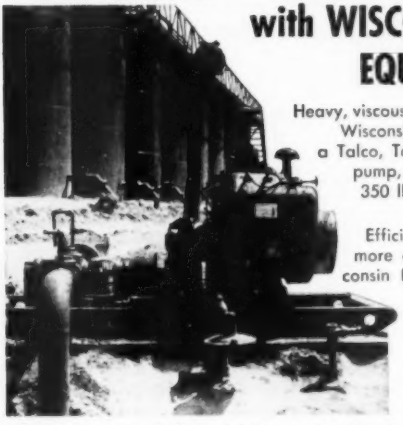

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Vermilion Parish: Bates & Cornell 1 Frank A. Godchaux & Sons, 83-14s-3e, dry, TD 11,500 ft.

Southwest Texas

Blackjack Gets First Oil Plus Another Gas Pay

CORPUS CHRISTI. — The first oil production has been opened in Blackjack field, Aransas County at Western Natural Gas and Continental Oil Co. 16 St. Charles Ranch, which flowed 240.12 bbl. of 48.7°-gravity oil daily from perforations at 8,288-98 ft. in the Frio. Production was gaged through ¼-in. choke.

A third pay is being opened in the same field at Western Natural 14 St. Charles, which flowed gas-condensate through perforations at 11,460-90 ft. On open flow gage, the well yielded 3,270,000 cu. ft. of gas daily plus an ungaged amount of 48.7°-gravity distillate. Blackjack field was discovered earlier this year by the same firm's 13 St. Charles, which was completed at 10,320-60 ft. The field is located 3 miles northeast of St. Charles Ranch gas field, on the Blackjack peninsula, 30 miles south of Tivoli.

Forney & Winn have set pipe and are preparing to test a highly saturated sand section in the Navarro zone at 1 Alma Marburger, wildcat south of Big Foot field, Frio County. Operators made hole to 3,536 ft. and set 5½-in. production string at 3,495½ ft. A drill-stem test of the interval at 3,495-536 ft., with tool open 45 minutes, showed a good surface blow. There was no recovery on the test due to packer failure.

Sam E. Wilson, Jr., Renwar Oil Corp., and Arkansas Fuel Oil Co. 1 State Tract 462-A, Mustang Island wildcat, Nueces County, recovered distillate on a drill-stem test and is now running tubing for completion. From perforations at 8,451-55 ft., recovery on the test was 140 ft. of distillate through ¼-in. chokes. Working pressure was 1,400 psi. This well is located 1½ miles east southeast of gas-distillate production in Mustang Island field.

In the new Knolle area of Nueces County, Panhandle Producing & Refining Co. 2 Knolle Farms, near that firm's recent gas discovery, recovered oil on a drill-stem test and is drilling ahead to core a deeper section. On the 15-minute drill-stem test at 5,168-74 ft., using ¼-in. chokes, recovery was a 1,000-ft. water cushion and 15 ft. of pipe-line oil.

SOUTHWEST TEXAS (DISTRICTS 1 AND 4) SUCCESSFUL WILDCATS

Aransas County: Western Natural Gas Co. 16 St. Charles, Block A-5, Aransas County School Lands Sur., TD 8,991 ft., Frio 8,288-98 ft., 240 bbl. oil, ¼-in. choke, gravity 48.7°.

Western Natural Gas Co. 14 St. Charles Ranch Co., Isaac Dowers Sur., A-53, TD 11,615 ft., Frio "B" 11,460-90 ft., 3,270,000 cu. ft. of gas.

Caldwell County: Southern Production Co. 1 Emil Willms, C. Crenshaw Sur., A-68, TD 1,364 ft., Edwards 1,327-31 ft., 18 bbl. oil per day, gravity 30°.

Jim Hogg County: Sun Oil Co. 47 A. C. Jones, Agua Nueva de Abajo Gr., TD 4,981 ft., perf. 4,909½ ft., 5,700,000 cu. ft. gas.

McMullen County: W. Earl Rowe & P. R. Rutherford 2 Earl M. Baker, Seale & Morris Sur. Sur. 7, TD 3,450 ft., perf. 1,824-36 ft., 8,000,000 cu. ft. of gas, SIP 760 psi.

Nueces County: Renwar Oil Corp. and Phillips Petroleum Co. 1 J. C. Blacknall, O. R. Warner Sur. 74, TD 6,500 ft., perf. 6,098-6,101 ft., ungaged gas well.

SOUTHWEST TEXAS (DISTRICTS 1 AND 4) WILDCAT FAILURES

Atascosa County: W. W. Carter 1 L. W

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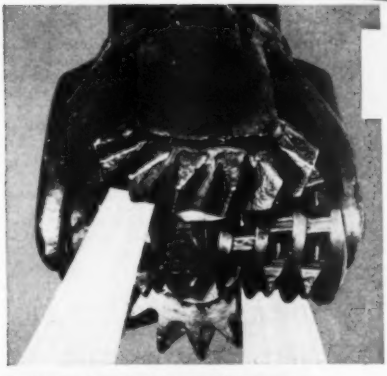

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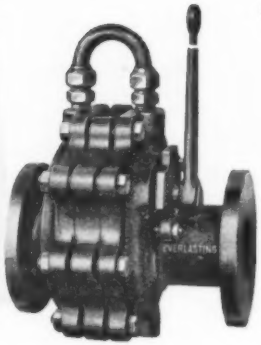

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Stieren et al, James P. Gorman Sur. 1,189, A-282, dry, TD 7,521 ft.

Blanco County: C. W. Casten 1 J. F. Flannery, Henry Manton Sur., Sec. 17, dry, TD 3,500 ft.

Kenedy County: Humble Oil & Refining Co. 1 King Ranch-San Jose Farral, San Juan de Carricitos Gr., dry, TD 12,000 ft.

Milam County: Pryor Dillard 1 A. J. Mondrick, Juan Jose Acosta Sur., dry, TD 1,533 ft.

Nueces County: Skelly Oil Co. 1 Atkinson, Geo. H Pauls Subd., Sec. 51, dry, TD 8,202 ft.

Stanolind Oil & Gas Co. 1 State Tract 420, Corpus Christi Bay, dry, TD 8,305 ft.

Starr County: Kirkwood & Co. and Ranger 1 Fidel Perez et al, Porcion 104, Share 123, dry, TD 3,715 ft.

Eastern Texas

Freestone County Well Taps Two Gas Zones

DALLAS—Gas production, with some distillate, seems assured from two horizons at Pure Oil Co. 1 Rufus Howard, J. Lawton Survey, A-365, discovery 2½ miles northwest of Teague, Freestone County. On a 12-hour test from 6,787-6,879 ft. in the Podesta through a ¾-in. choke, the well flowed at the rate of 2,278,000 cu. ft. of gas daily. Operator then perforated the Pettit from 7,213-7,383 ft. On a 5-hour test through ¼-in. choke, gas volume was 960,000 cu. ft. a day with 16 bbl. of water-white distillate. Tubing pressure was 2,740 psi. Yet to be tested is the Travis Peak, where gas production also was indicated.

Another gas-distillate discovery is Arkansas Fuel Oil Co. 1 H. M. Riley, D. C. Moore Survey, 3 miles southeast of Scottsville, Harrison County. The well kicked off after being washed with 500 gal. of mud acid through perforations from 6,170-65 ft. in the Pettit lime. Flew was through 20/64-in. choke. No estimate was made as to flow. The operator will test at other levels.

Midstates Oil Corp. 1 John Bender, W. W. Holman Survey, southeast outpost in the north section of Woodlawn field, set casing after showing for a producer on a drill-stem test in the Pettit. The test was run from 6,364-94 ft. Recovery was 60 ft. of distillate and 60 ft. of distillate-cut mud.

R. J. Caraway will drill a 12,500-ft. test 1 mile southwest of his 1 Tuckett, gas-distillate discovery in Rains County, 6 miles southeast of Emory. The test is 1 R. M. Sharp, 660 ft. out of the northeast corner of the A. Woodring Survey.

EAST TEXAS (DISTRICTS 5 AND 6) SUCCESSFUL WILDCATS

Anderson County: The Texas Co. 1 C. W. Hanks, I. Lindsey Sur., 2½ mi. W Fosterville, TD 10,758 ft., elev. 454 ft., perf. 10,094-104 ft. James, flowed 120 bbl. 56 -gravity oil a day, 9/64-in. choke, est. 50,000,000 cu. ft. gas day, GOR 9,800 cu. ft., TP 3,500 psi., CP 4,050 psi.

Cherokee County: Dennis & Hunter 1 O. L. Newburn, F. J. Anthony Sur., 5 mi. NE Mt. Selman, TD 4,371 ft., perf. 4,350-53 ft., flowed 8,800,000 cu. ft. gas per day plus 60 bbl. 56 -gravity distillate per 1,000,000 cu. ft. gas, open flow, Woodbine 4,348 ft.

EAST TEXAS (DISTRICTS 5 AND 6) WILDCAT FAILURES

Collin County: Clark & Cowden et al 1 J. H. Williams, Blk. 14, J. Rutherford Sur., 2 mi. NE Blueridge, dry, TD 2,750 ft., Paluxy 2,645 ft.

Henderson County: Iowa-Payne Oil Co. 1 N. C. Larkin, J. N. Villereal Sur., 12 mi. NE Athens, dry, TD 4,807 ft., elev. 650 ft., Woodbine 4,602 ft.

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North Central Texas

Ellenburger Pay Found In Wilbarger County Test

WICHITA FALLS — A new Ellenburger discovery for Wilbarger County is E. R. Perkins 1 W. T. Waggoner estate, Section 49, Block 2, H&TC Survey. On a drill-stem test from 3,873-82 ft., there was gas to the surface in 2 minutes and oil in 40 minutes. Recovery was 3,000 ft. of oil and no water. Ellenburger was topped at 3,802 ft.

J. J. Lynn 1 First National Bank, Baylor County Strawn sand discovery, 10 miles east of Seymour, swabbed 3½ bbl. of oil an hour from 4,747-52 ft. On a 1-hour drill-stem test, the section yielded 1,350 ft. of free oil and 20 ft. of heavily oil-cut mud with a slight taste of salt water.

Oil was recovered on two drill-stem tests of the Caddo at The Texas Co. 1-B W. H. Groves estate, wildcat 6½ miles north of Cisco, Eastland County. Seven-inch casing has been set at 3,447 ft. for completion attempt in open hole to 3,469 ft.

Seaboard Oil Co. and Continental Oil Co. 1 Billie Hanks, Pennsylvanian discovery prospect in Nolan County, was being tested in the lower Pennsylvanian from 5,850-82 ft. where some oil shows were logged in cores. Earlier this wildcat flowed oil on a a drill-stem test from 4,598-4,605 ft. in the Canyon reef. A test of the Strawn from 5,418-36 ft. recovered 1,410 ft. of clean oil and 90 ft. of heavily oil and gas-cut mud.

Another Ellenburger prospect is S. Caprito 1 Compton-Hazelwood, southwestern Stephens County, 6 miles south of Eolian. Production was indicated on a 1-hour drill-stem test from 4,175-4,211 ft. Recovery was 180 ft. of clean oil and 180 ft. of oil-cut mud.

NORTH CENTRAL TEXAS (DISTRICTS 9 AND 7-B) SUCCESSFUL WILDCATS

Archer County: C. G. Butts 1 J. M. Kunkel, S. G. Hardaway Sur., 3 mi. N Olney, TD 1,179 ft., pay 1⅛173 ft., pumped 45 bbl. 40°-gravity oil.

Eastland County: Stapper & Shirley 2 Robert E. Adams, Sec. 54, Blk. 3 & 4, McLennan CSL Sur., 4½ mi. SE Eastland, TD 1,561 ft., elev. 1,455 ft., pry. 1,557 ft., pumped 7 bbl. 37°-gravity oil, open hole.

Grayson County: Mid-Continent Oil Corp. 1 E. L. Coleman, J. D. McLeod Sur., A-870, 5 mi. W. Haverman, TD 8,343 ft., elev. 733 ft., pay 8,002 ft., flowed 211 bbl. 38°-gravity oil, 16/64-in. choke, GOR 628 cu. ft., CP 750 psi., TP 250 psi.

Jack County: Bridwell Oil Co. 1 H. O. Prideaux, Sec. 1, SPRR Sur., A-581, TD 3,634 ft., pay 3,611 ft., flowed 77 bbl. 41°-gravity oil, ¾-in. choke, GOR 420 cu. ft., CP 50 psi., TP 50 psi.

Jones County: S. C. Herring Drlg. Co. 1 Eula L. Phillips, League 332, Harrison CSL Sur., 5 mi. W Anson, TD 3,207 ft., PB 2,920 ft., pay 2,896 ft., pumped 27 bbl. 36°-gravity oil, perf. 2,896-2,500 ft., Gunsite 2,898 ft.

Montague County: Geo. S. Engle 1 Fenoglio, John Brumley Sur., A-97, 1½ mi. N Montague, TD 6,415 ft., pay 5,966 ft., flowed 183 bbl. 40°-gravity oil, 2-in. choke, perf. 5,966-81 ft., GOR 310 cu. ft.

B. M. Hester & Sons 1-A Arche Durham, Blk. 1593, R. H. Grimes Sur., 5 mi. NE St. Jo, TD 1,765 ft., elev. 965 ft., pay 1,760 ft., pumped 41 bbl. 42°-gravity oil.

Shackelford County: McMillian, Lee & Hughes et al 1 W. D. Baker, 1-14-T&P, 7 mi. SW Lueders, TD 1,638 ft., elev. 1,746 ft., pay 1,624 ft., pumped 88 bbl. 39°-gravity oil.

Stephens County: Homer T. Glover, Tr. 2 J. I. Eddleman, 44-6-T&P, 2 mi. NE Frankel, TD 2,048 ft., elev. 1,428 ft., pay 2,036 ft., pumped 49 bbl. 40°-gravity oil.

Taylor County: Miami Oper. Co., Inc. 1 Bettes, 143-64-H&TC, 3½ mi. E Shep, TD 4,848 ft., elev. 2,275 ft., pay 4,803 ft., pumped 65 bbl. 40°-gravity oil.

Wilbarger County: Frank Wood 1 W. T. Waggoner "P," 16-4-H&TC, 15 mi. SW Harrold, TD 2,484 ft., pay 2,457 ft.,

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NORTH CENTRAL TEXAS (DISTRICTS 9 AND 7-B) WILDCAT FAILURES

Archer County: Southern Petroleum Corp. and Chas. E. Morrison 1-G L. F. Wilson, Lot 9, Blk. 117, ATNCL Sur., 5½ mi. N Archer City, dry, TD 3,980 ft.

Brown County: Dean Brothers 1 E. F. George, C. B. Banister Sur., 6 mi. NW Bangs, dry, TD 1,350 ft.

Clay County: American Liberty Oil Co. 1 Wylie Taylor, BBB&C Sur. A-785, 1 mi. NE Dean, dry, TD 4,655 ft.

Hull Oil Co. 3 Allen Rodgers, Sec. 319 and 744, A. McGowan and Wm. A. Young Sur., 3 mi. NW Petrolia, dry, TD 1,203 ft.

Warren Oil Co. 1 Avis est., Blk. 13, Rains CSL Sur. A-775, 3 mi. SW Jolly, dry, TD 5,096 ft.

Coleman County: H. B. Ownby Drlg. Co. 2 M. L. Stone, Dugold McLean Sur. No. 757, 3½ mi. N Talpa, dry, TD 3,652 ft., elev. 1,973 ft., Gardner 3,590 ft., Gray 3,620 ft.

Yeatman Drlg. Co. 1 E. C. Coursey, Sec. 28, W. Savage Sur., 4 mi. E Coleman, dry, TD 3,225 ft., elev. 1,950 ft., Capps 3,155 ft.

Cooke County: Broday Drlg. Co. 1 A. Durham, Jas. Ferguson Sur. A-261, ½ mi. W Cops Corner, dry, TD 2,629 ft.

L. O. McMillan 1 Margaret B. Miner, D. H. Saunders Sur. A-1279, 3 mi. NW Callisburg, dry, TD 6,143 ft.

Fisher County: Taubert Drlg. Co. 1 W. G. Graham, 10-19-T&P Sur., 5 mi. NE Eskota, dry, TD 4,445 ft., elev. 1,840 ft., Flippen 2,855 ft.

Haskell County: Basin Oil Co. of Calif. 1 J. N. Fields, H. O. Campbell Sur., Sec. 18, 2 mi. SE Haskell, dry, TD 4,623 ft., elev. 1,586 ft.

Jones County: Pethybridge-Wolfson 1 Mrs. E. T. Brooks, Sec. 4, Blk. 360, Goliad CSL Sur., 11 mi. W Anson, dry, TD 3,465 ft.

R-H-K Drlg. Co. and Street Investment Co. 1-A Joe Winter, 19-19-T&P, 6 mi. N Trent, dry, TD 4,537 ft.

King County: Gulf Plains Corp. 1 Masterson Ranch, Sec. 6, Blk. A, R. M. Thompson Sur., 15 mi. NE Guthrie, dry, TD 5,490 ft.

Montague County: Standard Oil of Texas 1 J. R. Brown et al, Ralph Graves Sur. A-293, 3½ mi. NW Spanish Fort, dry, TD 2,310 ft., elev. 775 ft.

Shackelford County: Faustgen & Moran 1 William L. Bailey, 51-14-T&P, 12 mi. NE Abilene, dry, TD 2,095 ft.

Big West Drlg. Co. 1 J. H. Nail, Sec. 76, ETRR Sur., 12 mi. NW Albany, dry, TD 1,701 ft., elev. 1,625 ft.

Big West 1-19 J. H. Nail, Sec. 96, ETRR Sur., dry, TD 1,557 ft.

Big West 1-20 J. H. Nail, Sec. 103, ETRR Sur., dry, TD 1,766 ft.

Big West 1-21 J. H. Nail, Sec. 131, ETRR Sur., dry, TD 1,455 ft.

Big West 1-27 J. H. Nail, Sec. 47, ETRR Sur., dry, TD 1,177 ft.

Big West 3-8 J. H. Nail, Sec. 48, ETRR Sur., dry, TD 1,238 ft.

Big West 3-14 J. H. Nail, Sec. 68, ETRR Sur., dry, TD 1,398 ft.

Hickok & Reynolds 1-B Chloe A. Nail, Sec. 138, ETRR Sur., 20 mi. NW Albany, dry, TD 1,686 ft., elev. 1,722 ft.

Wilcox Investment Co. 2 W. D. Lummus, Blk. 6, BOAL Sur., 6 mi. NE Moran, dry, TD 2,063 ft., elev. 1,343 ft.

Stephens County: Max McCotter et al B-1 M. Graham, 81-4-T&P Sur., 14 mi. NE Ranger, dry, TD 1,801 ft., elev. 1,379 ft.

Stonewall County: H. W. Martin 1 Kenneth Scott, 134-1-BBB&C, 10 mi. NE Hamlin, dry, TD 3,400 ft., elev. 1,717 ft., Gunsite 3,208 ft., Swastika 3,365 ft.

Taylor County: Southern Minerals Corp. 1 K. L. Swiedom, Plummer Sur. No. 530, 3¼ mi. W Ovalo, dry, TD 4,826 ft., elev. 2,138 ft.

Wilbarger County: P. C. Burns 1-B R. L. Castleberry, 66-14-H&TC, 9 mi. S Vernon, dry, TD 1,559 ft.

R. Clay Underwood 1 W. T. Waggoner Est., 25-6-H&TC, 10 mi. SE Electra, dry, T 1,955 ft., elev. 1,140 ft.

Frank Wood 1-RR W. T. Waggoner, 57-4-TE&L, 8 mi. SW Harrold, dry, TD 2,105 ft.

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Mississippi

Lion Oil Prepares to Test Apparent Wilcox Strike

JACKSON.—A new Wilcox discovery in southwestern Franklin County, is indicated at Lion Oil Co. 1 Thomas, 3-4n-1e, in the Freenwoods area. Bottomed at 7,220 ft., electric log and sidewall samples indicated a total of approximately 20 net feet of oil and sand between 6,096-6,526 ft. The sands with shows were as follows: 6,096-98 ft.; 6,101-03 ft.; 6,275-86 ft.; 6,380-88 ft.; 6,391-96 ft.; 6,483-87 ft.; 6,519-21 ft. Operator is preparing to run casing to test.

In Pike County, Humble Oil & Refining Co. continues extensive efforts to establish production at 1 Bill Fortenberry, 27-2n-9e. A Hydrafrac treatment was made of the lower Tuscaloosa through perforations at 10,742-75 ft. It is reported that the formation was broken down with 4,000 psi. maximum pressure. After this treatment, a 24½-hour drill-stem test was run with recovery being only 4 bbl. of mud cut with diesel fuel. The well was then plugged back and perforated at 9,730-60 ft. in the upper Tuscaloosa. Recovery from another drill-stem test was mud and salt water. At last report, operators were preparing to squeeze and continue testing.

Approximately 4,700 ft. southeast of the Pistol Ridge field discovery well, Forrest County, I. P. LaRue and American Liberty Oil Co. are preparing to drill-stem test 1 Crosby Forest Products Co., 17-1s-13w. Recovery from a core in the lower Tuscaloosa at 8,080-90 ft. was 4 ft. of porous sand with

good condensate odor and 5 ft. of tight sand with slight condensate odor. The field discovery was completed as a gas well in the upper Tuscaloosa sand at 7,724-36 ft.

Stanolind Oil & Gas Co. reports a failure at its wildcat in Escambia County, Alabama. The firm's 1 F. A. Steward, 11-1n-8e, produced a small amount of 25°-gravity oil but the amount of salt water was too great. The well was bottomed at 6,575 ft.

MISSISSIPPI WILDCAT FAILURES

Adams County: Calto Oil Co. 1 Mrs. George Ward, 55-7n-2w, dry, TD 6,513 ft.

Gulf Refining Co. 1 L. A. Whittington "A," 34-7n-14w, dry, TD 6,454 ft.

Plains Production Co. 2 A. H. Sojourner, 12-5n-2w, dry, TD 6,764 ft.

Paul Ratliff 1 Francis Geddes, 25-5n-1w, dry, TD 7,611 ft.

Sinclair Oil & Gas Co. 3 Hogue est., 19-5n-4w, dry, TD 7,496 ft.

Sunnyland Contracting Co. 1 Mrs. Martha Bailey, 47-6n-2w, dry, TD 6,575 ft.

Sunnyland Contracting Co.-B. Serio 1 R. Hicks Parker, 64-7n-1w, dry, TD 6,546 ft.

Jefferson County: L. A. Grelling, et al, 1 J. M. Dyess, et al, 29-6n-18w, dry, TD 10,015 ft.

ALABAMA WILDCAT FAILURES

Escambia County: Stanolind Oil & Gas Co. 1 F. A. Steward, 11-1n-8e, dry, TD 6,575 ft.

Mobile County: Gulf Refining Co. 1 Alabama State Hospital "B," 36-2n-1w, dry, TD 11,014 ft.

Monroe County: W. F. Hamilton-L. Cashion Co. 1 St. Regis Paper Co.-Florida Oil & Gas Co., 10-3n-5e, dry, TD 6,809 ft.

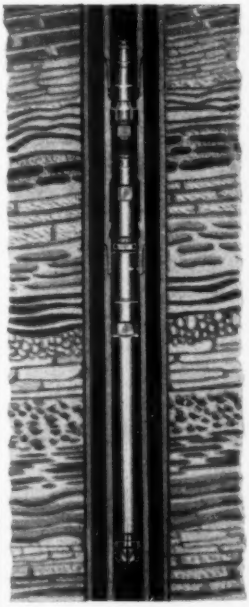
Kansas

Oil Production Indicated In Gove County Wildcat

GOVE County, in the far western part of the state, has another prospective pool where Herndon Drilling Co. and associates found promising oil showings in the Lansing-Kansas City section at its 1 Jasper, NE NE NE 30-15-29. The prospective discovery well, located in the extreme southern part of the county, 2 miles north of the Lane County line, is approximately 8 miles southwest of the Coberly pool, opened last May by Cities Service Oil Co. as the county's first, and so far only commercial production. It is about 6 miles south of a recently abandoned wildcat (Glenn Nye Drilling Co. 1 Lundgreen, NW NW NW 29-14-29) which failed to develop commercial production after testing showings in the Mississippian.

The Lansing zone in the Herndon Drilling Co. well was topped at 3,638 ft. (1,086 ft.), 27 ft. higher than in the Coberly discovery well. Best showings were in an interval at 3,661-3,726 ft., where a drill-stem test, open 60 minutes, yielded 435 ft. of oil and 15 ft. of heavily oil and gas-cut mud. Another test with hole deepened to 3,735 ft. and taking in the interval below 3,718 ft. got 90 ft. of oil-cut mud. Bottom-hole pressure in the first test was 850 psi, and in the second test 1,100 psi. At latest report, hole was being deepened to the Marmation zone, the producing horizon of the Coberly pool.

Another rank wildcat in Decatur County, in the extreme northern part of the state, where first production was opened the latter part of September, also has encountered promising oil showings. It is Peel & Hardman 1 Vosak, SE SE NE 4-4-26. Showings were in the Lansing section, topped at 3,497 ft. (—982 ft.). A drill-stem test, open 15 minutes, recovered 8 ft. of oil-cut mud with a small amount of free oil. Hole has been drilled to Arbuckle lime, topped at 3,964 ft., where operators expect to run casing. Location is about 9 miles northeast of the county's recently completed first oil producer, The Texas Co. 1 Keenan, in the NW NW SE 24-5-27. Pay



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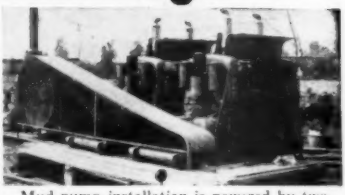
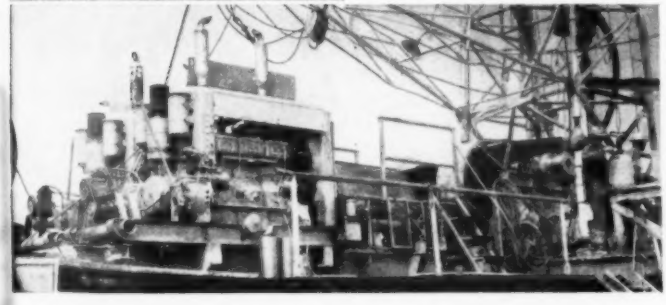
Beene-Hurley Use Low Cost Power on Frank's Rig!

Drillers Beene and Hurley at Bossier City, La., use Frank's portable rig with four Minneapolis-Moline 1210-12A units for power. They are drilling low-cost wells to depths of 6500 feet. The 1210-12A, 12 cylinder unit engines are factory equipped to operate on LP gas or natural gas—the low priced fuels in this area.

Beene and Hurley have mounted two of these units on the drilling table to furnish power to the draw works. These engines are equipped with front power take-off drives and supply 400 hp with LP gas. The other 1210-12A units are remotely located on the mud pump. The complete engineering and installation was done by Beene and Hurley at Shreveport.



Mud pump installation is powered by two MM 1210-12A's.



Two MM 1210-12 on the drilling table operate on low-cost, higher octane LP gas.

This arrangement combines flexibility of layout with important time saving for setting up the rig. Precision tooling and high production methods account for the extremely low selling price of MM heavy-duty oil field power units. Standardization of parts permits interchangeability which assures easier, lower-cost maintenance.

Sales and service of MM oil field engines are handled by the Shrimpton Manufacturing and Supply Co., with branches at Los Angeles, California; Oklahoma City, Oklahoma; and Kilgore, Texas.

zone of the latter well also is the Lansing, topped at 3,407 ft. (—908 ft.).

Testing is under way at Iron Drilling Co.'s prospective discovery well, 1 Boyer, NW NW NW 23-30-8, a mile south of Spivey. In southern Kingman County. With casing perforated at 4,238-60 ft. in the Mississippian, topped at 4,168 ft. (—2,653 ft.), the well produced at the rate of 7 bbl. of oil per hour by swabbing after acidization with 4,000 gal. While drilling, the well had good showings from the top of the Mississippian, as well as in the Lansing-Kansas City lime, topped at 3,407 ft. (—892 ft.). No showings were found below the Mississippian with hole drilled to a total depth of 4,755 ft. in Arbuckle. Location of the well is 15 miles from nearest production.

Anschutz Drilling Co. 1 Braun, SW NE NE 34-13-17, a wildcat north of the Toulon pool, in Ellis County, swabbed 7 bbl. of oil per hour for 3 hours from a total depth of 3,494 ft. in Arbuckle lime, topped at 3,481 ft. (—1,504 ft.) Hole is open below 3,482 ft. Operators will reacidize for additional testing. Although only ¾ mile from production, the well is separated by dry hole and probably opens a new pool.

KANSAS WILDCAT FAILURES

Barton County: Beardmore Drilling 1 Eveleigh, NE NE SE 27-16s-14w, dry, TD 3,513 ft.

Butler County: Springer et al 1 Shinn, SE SE SE 30-29s-8e, dry, TD 2,765 ft.

Graham County: Gore 1 Hoof, NW NW SW 9-10s-23w, dry, TD 4,277 ft.

Morris County: Woods Drilling 1 Zannley, SE SE SW 16-14s-8e, dry, TD 2,062 ft.

Pawnee County: Pabco Drilling 1 Schmidt, NE NE SE 17-21s-15w, dry, TD 3,850 ft.

Rice County: Flynn Oil 1 Taylor, SE SE NE 20-21s-10w, dry, TD 3,395 ft.

Rooks County: Barnett Drilling 1 Harlan, NE NE SW 34-10s-20w, dry, TD 3,720 ft.

Trego County: The Texas Co. 1 Merrill, NE SE SE 34-12s-21w, dry, TD 3,935 ft.

C-G Drilling 1 Olson, SE SE SW 15-12s-22w, dry, TD 4,103 ft.

Anschutz Drilling 1 Rhoden, SW SW SE 14-12s-23w, dry, TD 4,247 ft.

KANSAS SUCCESSFUL WILDCATS

Graham County: Deep Rock et al 1 Beecher, NW NW NE 6-10s-21w, pumped 195 bbl. oil from Arbuckle topped at 3,880 ft., TD 3,882 ft., opens West Smith-Denning pool.

Rice County: Flynn Oil 1 Mayer, NW SE SE 4-22s-8w, pumped 10 bbl. oil from Mississippian topped at 3,365 ft., TD 3,395 ft., reopens Sterling pool.

Texas Gulf Coast

Rank Wildcat Tests Oil In NE Grimes County

HOUSTON.—In Grimes County, approximately 7½ miles northeast of Shiro, Woodley Petroleum Co. and Stanolind Oil & Gas Co. 1 Iris Clark et al tested oil from the Wilcox at 4,688-92 ft. and operators are preparing to complete. This well was drilled to total depth of 8,198 ft., and electric log was run which detected shows around 4,700 ft. Side-wall cores of that section merited casing the hole for further investigation. The well flowed an ungaged amount of oil, gas, mud and water through ⅛-in. choke. Gravity of the oil was 35°.

Potential test has been run on the newly established Yegua pay zone in Helen Gohlke field, DeWitt County. Shell Oil Co. 4 Helen Gohlke made 114 bbl. of oil daily through casing perforations in the Yegua at 5,354-48 ft. Dually completed, the well also flowed 200 bbl. of oil from the Wilcox at 8,132-44 ft. Flow was gaged through 10/64-in. choke.

In Calhoun County, Quintana Petroleum Corp. 1 Lillie I. Roemer, possible northeast extension to South Long Mott field, tested oil and condensate on drill-stem test. On 3-hour and 15-minute test, from perforations at 7,740-46 ft., recovery was salt water cut with oil. Operator squeezed and reperforated at 7,390-7,424 ft. On this test, the well developed 2,850 psi. working pressure and had recovery of 55.7°-gravity condensate. Bottom-hole flowing pressure was 4,000 psi.

Sinclair Oil & Gas Co. has opened a new gas-condensate reservoir in Old Washington field, Washington County, approximately 4 miles southwest of Courtney. The well, 2 Bess Henry, William Gates League, Abstract 46, confirmation test to the firm's 1 Bess

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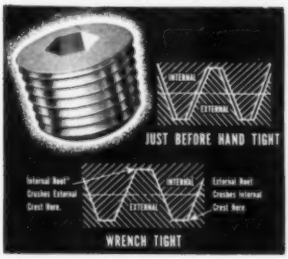

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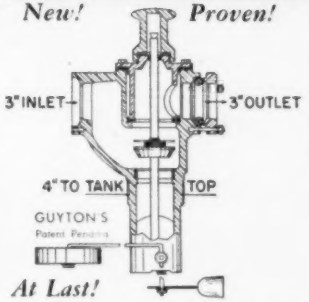

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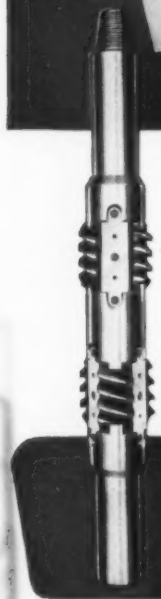

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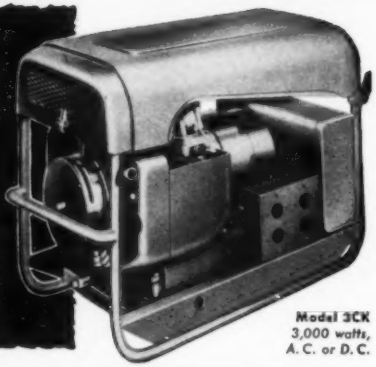

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Henry, flowed approximately 20 bbl. of 63.3°-gravity distillate from the Wilcox at 8,951-56 ft. The well is 1,650 ft. due west of 1 Henry, field discovery well which flowed 243 bbl. of oil from perforations at 9,214-18 ft.

Hull field in Liberty County has been extended to the west at Houston Production Co. 1 R. D. Patrick. It was finaled for 532 bbl. of 36°-gravity oil daily from casing perforations at 8,115-32 ft.

In the same county, South Dayton field has been extended to the south at The Texas Co. 1 R. E. Brooks, NCT-2. The well is credited with 249 bbl. of oil daily through perforations at 8,987-93 ft. and 8,996-9,000 ft. Gravity of the oil was 32.5°.

TEXAS GULF COAST (DISTRICTS 2 AND 3) SUCCESSFUL WILDCATS

Bee County: Heep Oil Corp. B-1 Claude E. Heard, Jeremiah Tool Sur., A-66, TD 4,955 ft., perf. 4,274-80 ft., 25,000,000 cu. ft. of gas.

R. S. Randerson 1 Slick, J. M. Thurston Sur., A-315, TD 3,500 ft., perf. 3,201-13 ft., 13,000,000 cu. ft. of gas, SIP 1,097 psi.

TEXAS GULF COAST (DISTRICTS 2 AND 3) WILDCAT FAILURES

Bee County: Morris Cannan & R. D. Mebane 1 Mrs. W. S. Harris, C. B. Shain Sur., A-305, dry, TD 7,512 ft.

Brazoria County: Robert H. Merritt 1 J. W. Campbell est., S. M. Williams League, dry, TD 5,510 ft.

Burleson County: Roy Davis 1 J. W. Lewis, C. H. Bennett League, dry, TD 4,558 ft.

Galveston County: Dillard-Waltermire, Inc., 1 Rosetta M. Rogers et al, I&GN RR Sur. 12, A-600, dry, TD 10,626 ft.

Harris County: Joyce Richardson Wolfe 1 E. Ferdie & J. R. Trichelle, Arthur McCormich Sur., A-46, dry, TD 7,534 ft.

Jasper County: Standard Oil Co. of Texas 1 Kirby Lumber Corp. 2, T&NO Sec. 11, A-488, dry, TD 7,802 ft.

Karnes County: L. R. Allison 1 John Hancock Life Insurance Co., Caspeh Flores Sur., A-1, dry, TD 6,825 ft.

Chicago Corp. 1 S. W. Borg, Carlos Martinez Sur., dry, TD 3,502 ft.

Chicago Corp. 1 D. E. Smith, Carlos Martinez Sur., A-6, dry, TD 3,500 ft.

Lavaca County: Hassie Hunt Trust 1 W. E. Appelt, Luke J. Presnall Sur., A-355, dry, TD 9,022 ft.

Matagorda County: Rowan Oil Co. and Texas Gulf Producing Co. 1 Ivan A. Kana, GC&SF RR Sur., A-462, dry, TD 8,525 ft.

Victoria County: Gulf Oil Corp. 1 Sophie Brown et al, J. B. Kibbe Sur., A-126, dry, TD 9,269 ft.

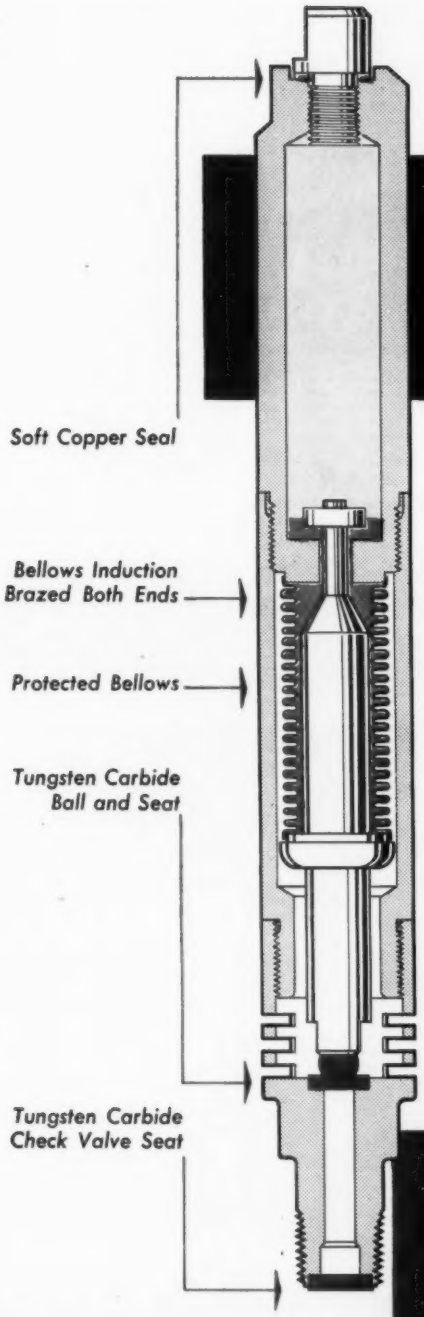
Union Oil Co. of California 1 C. K. McCan et al, Mrs. Eliza McFaddin Sur., A-527, dry, TD 6,477 ft.

Appalachian-Ohio

Big Gas Wells Highlight Activity in Eastern Fields

PITTSBURGH.—In Harvey district, Mingo County, West Virginia, United Fuel Gas Co. 23-6769 Central Trust Co. gaged 2,994,000 cu. ft. of gas in the Big lime. The well was bottomed at 1,720 ft. Another good gas well was brought in in Union district, Putman County: West Virginia Gas Corp. 1-561 R. G. Little reported 2,742,000 cu. ft. of gas from the Brown shale. Total depth was 4,166 ft. In Union district, Preston County, Hope Natural Gas Co. 9638 Margaret C. Kraus; elevation 2,128 ft., recorded the Tully lime at 4,315-50 ft., and is drilling at 4,390 ft. Eberly & Snee 1 Clarence Jones, elevation 1,830 ft., is shut down at 4,630 ft. to run casing.

Southwest Pennsylvania.—In Loyalhanna Township, Westmoreland County, T. W. Phillips Gas & Oil Co. 2 Atlantic Crushed Coke Co. resulted in 2,305,000 cu. ft. of gas, and was completed at a depth of 3,238 ft. In Unity Township, Peoples Natural Gas Co. 1-4003 A. J. Dotterway, elevation 2,094 ft., is drilling at 636 ft. In South Buffalo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2,188,836	2,230,107	2,292,768	2,347,620	2,377,981
2,188,668	2,236,137	2,295,230	2,358,944	2,411,315

Other patents pending.

Township, Armstrong County, Pittsburgh Plate Glass Co. 2-839 Mary A. McGinley estate, elevation 1,153 ft., is drilling at 5,930 ft.

Maryland.—Three new tests were completed in the Garrett County gas area; one good producer and two failures (see wildcat paragraphs below).

MARYLAND SUCCESSFUL WILDCAT

Garrett County: Mid Atlantic Oil & Gas Co. 1 Blair Simmons, elev. 2,480 ft., 7,434,000 cu. ft. gas from 3,973-4,005 ft. after shot, chert 3,958 ft., Oriskany sand 4,079 ft., TD 4,186 ft.

MARYLAND WILDCAT FAILURES

Garrett County: C. E. Young 1 F. P. Smith, elev. 2,575 ft., dry, TD 4,967 ft., Tully 4,351 ft., Onondaga 4,905 ft., chert 4,937 ft.

Eagle Oil & Gas Co. 1 Emil Germain, elev. 2,420 ft., dry, TD 4,622 ft., Onondaga 4,005 ft.

OHIO

COLUMBUS.—A third Berea sand gas well was completed at Stone Creek in Jefferson Township, Tuscarawas County. The well is a southwest offset to the discovery, and is the 1 Wesley Mizer, Lot 34. Sand was found at 952-982 ft. and gaged 1,230,000 cu. ft. of gas, natural.

Dave Shaffer 3 Smith, Lot 4, Monroe Township, Holmes County, drilling for oil, struck 1,400,000 cu. ft. of gas in the top of the second Clinton. The gas blew down some as the hole is filling with oil, and both sands will be shot. The first sand was at 3,419-36 ft. and the second at 3,453 ft.

Wasson & Co. 1 R. S. Black, Lot 4, Licking Township, Muskingum County, made a good showing of oil in Clinton found at 3,040-84 ft., and 40 bbl. in 24 hours after shot.

National Gas Co. completed another good Newburg producer in Walnut Township, Fairfield County. On 5 J. S. Holliday, Section 14, sand was logged at 1,943-56 ft., and made 103 bbl. in 24 hours after shot.

OHIO WILDCAT FAILURES

Meigs County, Olive Township: B. H. Putnam et al. 1 B. L. Osborn, Sec. 7, Oriskany 4,240-50 ft., dry, TD 4,280 ft.

Wayne County, Franklin Township: Ohio Fuel Gas Co. 1 R. H. Hoffer, Sec. 1, Clinton 3,573-93 ft., dry, TD 3,648 ft.

Permian Basin

Reagan County Strike Completes in Spraberry

MIDLAND.—One mile south of its recent Wolfcamp discovery in Reagan County, Atlantic Refining Co. will complete 1-B J. D. Sugg in the Spraberry from 5,495-5,550 ft. Swabbed to test natural, the well kicked off and flowed 100 bbl. of oil in 8 hours through 20/64-in. choke. Changed to ½-in. choke, it produced 77 bbl. of oil in 8 hours with flowing tubing pressure of 400 psi. Nearest Spraberry production is 7 miles west at Stanolind Oil & Gas Co. 1-A F. E. Wade.

There was recovery of 41°-gravity oil on a drill-stem test of the Pennsylvanian from 9,710-60 ft. at Greenbrier Oil Co. 1 E. Windham, Upton County multi-pay prospect. Open 2 hours, gas was at the surface in 14 minutes. Recovery was 600 ft. of oil. Operator was drilling ahead. Nearest Pennsylvanian production is 3 miles northwest in Wilshire pool, where the discovery well was dually completed.

A Runnels County discovery, 2 miles southeast of Freeman pool, Vincent & Welch, Inc. 1 E. E. Brown, Jr., has been completed through 40/64-in. choke from 3,751-61 ft. for 52 bbl. of 41°-gravity oil daily.

Moore Exploration Co. 1 Noelke, new Irion County Ellenburger discovery 10 miles southwest of Mertzon, was testing after treating with acid in open hole from 7,806-38 ft. The well was flowing steadily at the rate of 15 bbl. hourly through ¼-in. choke. Gravity was 40°, and casing pressure was 660 psi.

High structural position of the Canyon reef has been reported for Standard Oil Co. of Texas 1 Kelichor, Hale County deepening operation 9½ miles northeast of Petresburg. The Canyon was topped at 8,324 ft., minus datum point of 3,044 ft., or 208 ft. high, to Amerada Petroleum Corp. 1 Kurfees, a 10,250-ft. failure 4½ miles to the northwest. Samples showed a trace of oil and coring was scheduled.

Richardson & Bass 1 J. F. McCabe, Mitchell County wildcat 5 miles north of Jameson pool of Coke County, cored from 7,246-56 ft. and recovered 10 ft., the bottom 3 ft. being dense Ellenburger with a sulfur odor. It was reported the well may be plugged back for completion attempt in a Pennsylvanian sand from 6,035-65 ft. where a drill-stem test uncovered a flow estimated at 5-6 bbl. of oil hourly. Tentative top of the Ellenburger was placed at 7,253 ft., minus datum point to 4,496 ft.

In Midland County, The Texas Co. 3-D Scharbauer, Pennsylvanian prospect 1 mile northwest of Hi-Lonesome Wolfcamp field, was flowing to clean out and test through perforations from 10,658-10,708 ft. On latest test, the well flowed 82.56 bbl. of oil in 6 hours through 18/64-in. choke.

WEST TEXAS (DISTRICTS 8 AND 7-C) SUCCESSFUL WILDCATS

Glasscock County: Sohio Petroleum Co. 4-A R. S. Davenport, 14-37-T&P, TD 7,147 ft., elev. 2,723 ft., pay 6,894 ft., flowed 484 bbl. 37°-gravity oil, 18/64-in. choke, GOR 669 cu. ft., TP 200 psi., Spraberry 6,883 ft.

Sohio 6-A Davenport, 14-37-15s-T&P, TD 6,970 ft., elev. 2,723 ft., pay 6,874 ft., flowed 505 bbl. 37°-gravity oil, 18/64-in. choke, GOR 666 cu. ft., TP 125 psi.

Pecos County: Sam Krasner, Tr. 1 M. P. Walker, 86-11-H&GN, TD 3,139 ft., elev. 2,355 ft., pay 3,100 ft., flowed 53 bbl. 39°-gravity oil, ½-in. choke, GOR 687 cu. ft., TP 20 psi., CP 360 psi.

Reagan County: Lloyd H. Smith and J. H. Snowden 1 O. L. Greer, 43-A-L&SV, 6 mi. N Stiles, TD 6,130 ft., pay 6,099 ft., Spraberry 6,095 ft., flowed 41 bbl. 39°-gravity oil.

Runnels County: Miami Operating Co., Inc. 1 McKissick, Sec. 15, Blk. 515, A. Lesoya Sur., 8 mi. NW Talpa, TD 3,775 ft., elev. 1,860 ft., Gardner 3,765 ft., flowed 23 bbl. 42°-gravity oil, 14/64-in. choke, TP 90 psi., GOR 500 cu. ft.

WEST TEXAS (DISTRICTS 8 AND 7-C) WILDCAT FAILURES

Dickens County: Placid Oil Co. 1 Guy Goens, Sec. 3, AB&M Sur., dry, TD 8,474 ft., elev. 2,744 ft., granite was 8,442 ft.

Howard County: Standard Oil Co. of Texas 1 Harvey L. Adams, 47-15-T3N-T&P, dry, TD 10,000 ft., elev. 2,682 ft., Spraberry 6,736 ft., reef 9,374 ft., Strawn 9,770 ft.

Lynn County: G & C Drilling Co. 1 Heinrich, 7-J-EL&RR, 5 mi. S Slaton, dry, TD 4,100 ft., elev. 3,046 ft., Yates 2,080 ft., San Andres 3,330 ft.

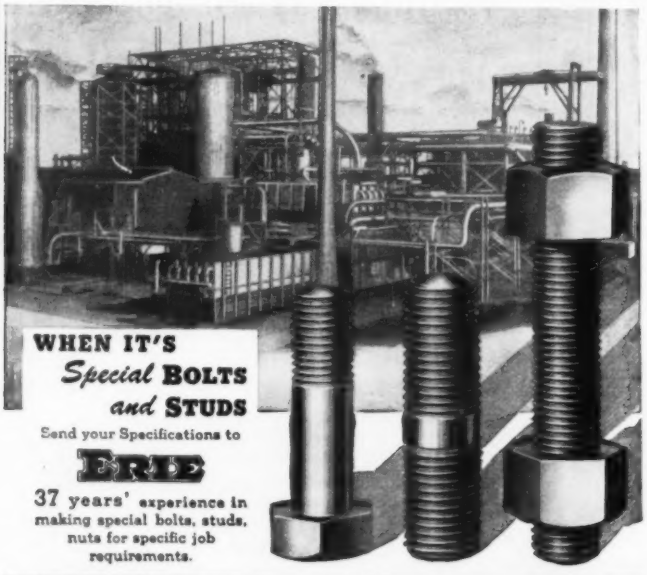
Midland County: Union of Calif. 1-A Mrs. O. P. Buchanan et al, G. Stover Sur. No. 2, dry, TD 8,090 ft., elev. 2,664 ft., Spraberry 7,203 ft.

Pecos County: Gulf Oil Corp. 1 Fulcher et al-State, 22-51-T10-T&P, 20 mi. NW Chancellor, dry, TD 5,463 ft., elev. 3,311 ft.

J. E. Smith 1 Holmes, 48-1-I&GN, dry, TD 2,405 ft.

Reagan County: C. M. Ashbey et al 1 Frank Lindley, 1-G-C&M, 1½ mi. N Stiles, dry, TD 7,090 ft., Spraberry 6,040 ft.

Runnels County: Hamilton Bros. 1 T. J. McCaugh, Sec. 14, Blk. 440, F. M. Fowler Sur., 7½ mi. SW Winters, dry, TD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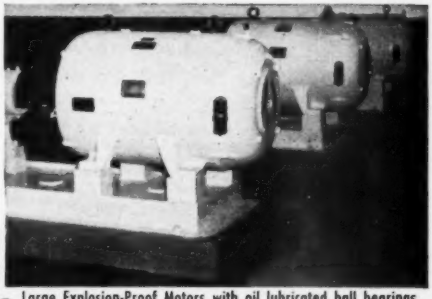

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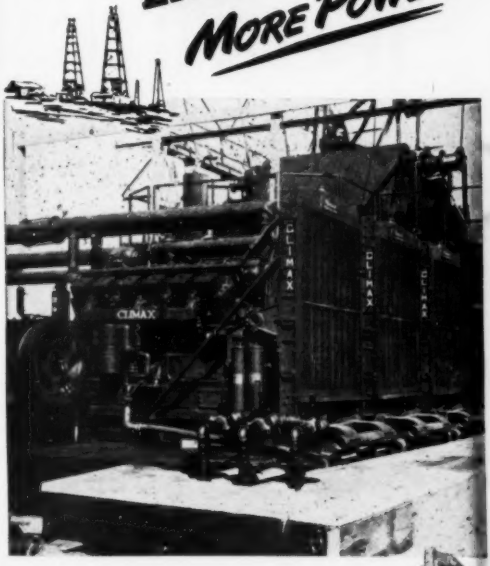

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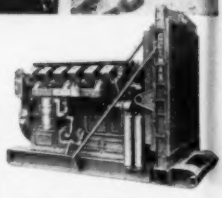

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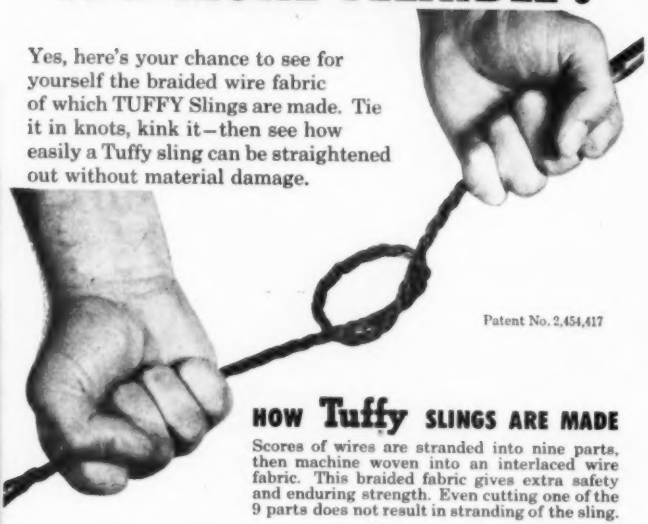

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5,008 ft., elev. 1,840 ft., Palo Pinto 3,867 ft., Capps 4,127 ft., Gardner 4,490 ft., Ellenburger 4,902 ft.

Sutton County: Sid Katz 1 Elsie P. Felthouse, Sec. 67, SPRR Sur., 30 mi. SE Sonora, dry, TD 4,350 ft., Ellenburger 4,150 ft.

TEXAS PANHANDLE (DISTRICT 10) WILDCAT FAILURE

Oldham County: Superior Oil Co. 3 Matador, League 331, 6½ mi. N Adrian, dry, TD 5,460 ft. in granite.

SOUTHEASTERN NEW MEXICO

HOBBS.—Cross Roads multipay pool of northeastern Lea County gained a ¾-mile extension with the completion of Magnolia Petroleum Co. 1-B State, 26-9s-36e, for 396 bbl. of 44°-gravity oil daily. Production was natural through ¾-in. choke and open hole from 12,130-37 ft. Gas-oil ratio was 21 cu. ft.

Phillips Petroleum Co. 1 Fort, 34-14s-37e, 1 mile northwest of the Denton area, will perforate from 12,660-12,710 ft. for completion attempt in the Devonian. Production also was indicated from the Wolfcamp.

On a 3-hour drill-stem test of the Clear Fork from 6,610-6,720 ft., Skelly Oil Co. 1-K Mexico-State, 29-24s-38e, had recovery of 540 ft. of gas-cut mud and 300 ft. of oil and gas-cut mud, estimated to be 25 per cent oil. The well is 1 mile north of 1-J Mexico-State, recent Ellenburger discovery, which also indicated production from the Queen's sand, Clear Fork, and Silurian. Drilling is continuing.

A Pennsylvanian pay for Maljamar field was indicated at Buffalo Oil Co. 12-B Baish on a 4-hour drill-stem test from 10,715-10,836 ft. Recovery was 4,070 ft. of 37.9°-gravity oil and 1,530 ft. of oil and gas-cut mud. Operator is drilling ahead.

SOUTHEAST NEW MEXICO SUCCESSFUL WILDCAT

Lea County: Amerada Petroleum Corp. 1 ECA-State, 14-12-32, TD 11,314 ft., elev. 4,364 ft., Devonian pay 11,240 ft., flowed 550 bbl. 43°-gravity oil, ½-in. choke, GOR 20 cu. ft., TP 100 psi., CP 11,090 psi.

SOUTHEAST NEW MEXICO WILDCAT FAILURE

Lea County: Stanolind Oil & Gas Co. 1-W State, 15-18s-37e, dry, TD 9,965 ft., elev. 3,714 ft., Tubbs 7,020 ft., Wolfcamp 8,995 ft., Mississippian 9,740 ft.

Rocky Mountain

Denver-Julesburg Basin Has Two New Prospects

DENVER.—Two new discoveries are near for the current exploratory campaign in the Denver-Julesburg basin. Ohio Oil Co. recovered 2,480 ft. of oil on drill-stem test at 1 Runge, SE NE SE 17-14n-50w, East Brownson area, Cheyenne County, Nebraska. The recovery was from the D sand between 4,754-69 ft. with tool open 30 minutes. The well is northwest of Dorman pool and the town of Sidney. In southeastern Wyoming, Morton & Sons, Long Beach, Calif., operators, found oil in their first Rocky Mountin wildcat. The well is 1 Rauner, C NE NW 31-14n-60w, Laramie County, on a block farmed out from Union Oil Co. of California. The well made 720 ft. of oil, 90 ft. of muddy oil, and 90 ft. of gas-cut drilling fluid in 1 hour from the "J" sand between 7,471-95 ft. A second test at 7,501-50 ft. showed only 60 ft. of thin mud in 1 hour and the operator is coring ahead.

Several Wyoming wildcats have had shows, with no commercial recoveries at the present time. In the Big Horn Basin, Stanolind Oil & Gas Co. found staining

at 1 Pepper, NW NW NE 28-55n-97w, in the Coon Creek area, Big Horn County. On a drill-stem test at 7,880-95 ft., with tester open 45 minutes, the recovery was only 50 ft. of mud. The operator is coring below 7,921 ft. with staining in portions of the hard, tight formation. Stanolind may drill the well to the Madison. Seaboard Oil Co. recovered heavy black oil on test of the Morrison (?) at the Whistle Creek wildcat, south of Elk Basin in Park County. The well is 1 State Unit, NE NW SW 16-46n-98w, and the zone tested was 4,382-95 ft. It made 540 ft. of black oil, with no gas, in 30 minutes. Seaboard plans the test to the Phosphoria, productive at the company's Silver Tip field, northwest of the present wildcat.

Another important deep test for Wyoming is Husky Oil Co. 1 Torgeson, C NE NE 29-49n-93w, in the Five Mile area, Big Horn County. This well, planned as a Phosphoria test, had flows of gas from the first and second Frontier sands, and is now in the third Frontier below 9,183 ft. The well is 4 miles northwest of Worland field where Pure Oil Co., as unit operator, has production from both Frontier and Phosphoria formations. At Logan Gulch, Fremont County, Far West Oil Co. et al found staining in hard, tight, fractured Phosphoria at 1 Government, NE NW NW 35-33n-93w. On a drill-stem test from 4,660-4,705 ft., the recovery was 40 ft. of gas-cut mud in 1 hour and the operator is coring ahead for a test of Tensleep.

COLORADO WILDCAT FAILURE

Weld County: Zimith Drilling Co. 1 Wilson, C NE SW 22-7n-63w, TD 7,502 ft., dry.

WYOMING SUCCESSFUL WILDCAT

Manderson, Big Horn County: General Petroleum-Pioneer Oil Co.-Mule Creek Oil Co. 34-20-G, C SE NW 20-50n-92w, TD 8,080 ft., flowed 480 bbl. 43.2°-gravity oil.

WYOMING WILDCAT FAILURES

Horse Track, Fremont County: Shell Oil Co. 2 unit, SE SE NE 28-27n-97w, TD 2,620 ft., dry.

West Dutton Basin: Amerada Petroleum Corp. 1 Government-Muller, C N/2 NW NE 1-32n-91w, TD 746 ft., dry.

Hawks Spring, Goshen County: Kingwood Oil Co. et al, 1 Smith, SE SE SW 6-20n-60w, TD 7,661 ft., dry.

Deadman, Johnson County: Husky Oil Co. 1 Gallup, NE SW SE 31-43n-79w, TD 7,814 ft., dry.

North Emigrant, Natrona County: Skelly Oil Co. 1 Wallway-Government, SW SW NW 10-34n-82w, TD 4,027 ft., dry.

Saddle Horse, Niobrara County: Hackathorn Drilling Co. 1 Degering, NE NW NE 29-36n-62w, TD 2,057 ft., dry.

Meeteetse, Park County: Wilshire Oil Co. 1 State, C S 2 SE SW Tract 48, 16-49n-99w, TD 11,454 ft., dry.

Pitchfork, Park County: Yetman-Morton 1 Pitchfork Ranch, NE NW NW 25-48n-103w, TD 2,784 ft., dry.

MONTANA WILDCAT FAILURES

Ryegate, Golden Valley County: Seaboard Oil Co. 2-20 Ice, SW NW NW 20-6n-20e, TD 3,640 ft., dry.

East Midway, Pondera County: Reserve Drilling and F. H. Gower 1 Wood, NE NE SE 27-28n-1w, TD 2,004 ft., dry.

NORTHERN NEW MEXICO SUCCESSFUL WILDCAT

San Juan County: Southern Union Gas Co. 1 Vanderslice, SE NW NW 19-32n-10w, TD 5,375 ft., 2,190,000 cu. ft. gas in 6 hours, Point Lookout 5,066-5,375 ft.

WESTERN NEBRASKA WILDCAT FAILURES

Southeast Gurley, Cheyenne County: Ohio Oil Co. 1 Dorman Farms, Inc., NE NE NE 8-15n-49w, TD 4,695 ft., dry.

South Chappell, Deuel County: Ben F. Brack Oil Co. 1 Gyger-Wilcox, NW NW NW 10-12n-45w, TD 4,090 ft., dry.

California

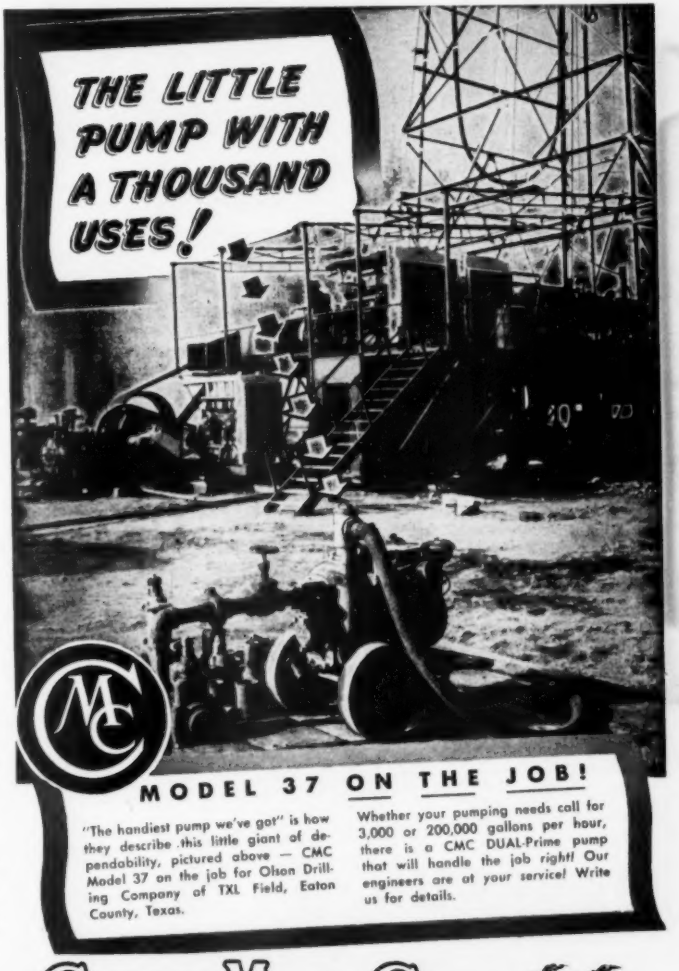
Humble Opens New Area In Central Kern County

LOS ANGELES. — Discovery of a new Stevens sand pool, located about 2 miles east of Greeley field in central Kern County, headed an unusually active week in California. A confirmation test has been staked about ⅝ mile northeast of the discovery so that a better idea of its importance shortly will be known.

The field opened was Humble Oil & Refining Co. 1 Rosedale-Stevens Community in NW SE 15-29s-26e. It topped the Stevens at 5,892 ft. and was completed flowing 507 bbl. of 31°-gravity oil daily through perforations at 5,890-5,955 ft., with 7-in. casing cemented at 6,017. Humble, which holds 2,700 acres of leases around the well, staked C-1 Kern County Land in SE SE Section 10.

Study of the records of dry wildcats drilled to the east, west, and south of the discovery, is believed to have led Humble to suspect the existence of major faulting. Its present was not proved by the test well, but a new field discovery was made. Dry holes apparently limit extensive development to the east and west but the new field could run generally north, or south, a few miles.

North of Arvin, on the southeast edge of San Joaquin Valley, an offset and step-out have been started by The Texas Co. to its recent discovery southeast of Mountain View field. About 1 mile northwest of the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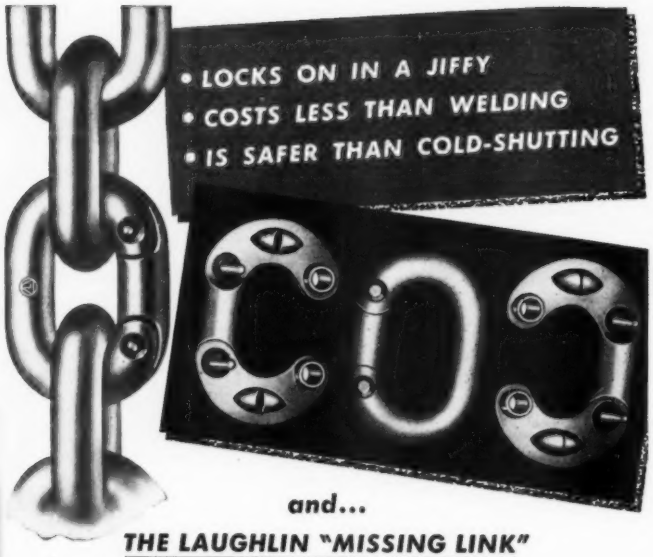

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6,500-ft. Santa Margarita sand discovery, its 1 Kern Valley was drilling below 2,600 ft. One location southeast of the discovery, 2 George, has been started. Another extension test has been announced for the field, C. B. Behr & Son 1 Berge about 1 mile to the southeast in SE NW Section 24. Havenstrite Oil Co. also has staked an extension try about ½ mile west of the discovery.

At Pleito Creek, on the southwest edge of Joaquin Valley, Humble's second well showed promise of being a much better producer than the discovery. The 2 K.C.L.-B flowed 9 bbl. in 30 minutes through a ⅛-in. bean from perforations at 3,377-3,644 ft. and 3,737-3,843 ft. The discovery, also in Section 35-11n-21w, was a 65-bbl. producer.

A wildcat which will be closely followed is The Texas Co. E Honor Rancho-2, staked midway between Honor Rancho field and the recent Ted Sterling discovery about 1¾ miles northwest. In Cuyama Valley, Richfield Oil Corp. was erecting derrick for 3 Russell-C in Section 2-10n-26w, 9 miles east of Russell Ranch. Another wildcat to get under way shortly will be R. B. Watkins 1 Coyote Hills, ¾ mile northeast of Brea-Olinda production in Section 4-3s-9w.

At Huron in Kings County, northern San Joaquin Valley, General Petroleum Corp. failed at its second deep test. The 48-3 Boston Land Co., in Section 7-20s-19e, was carried to 14,911 ft. with no showings reported.

CALIFORNIA SUCCESSFUL WILDCATS

Kern County: New field discovery in Devil's Den area, ¾ mi. W closest production—Gilliland Oil Co. and C. O. Davis 2 Strode, SE NE 15-25s-18e, flowed 200 bbl. 35°-gravity oil, perf. 3,183-3,250 ft., 16/64-in. bean, Eocene 1,624 ft., Point of Rocks oil sand 3,183 ft., TD 3,335 ft., PB 3,250 ft., elev. 633 ft.

New upped middle-Miocene discovery in Bacon Hills area—Superior Oil Co. 54-20 Theta, EW NE 20-28s-20e, flowed 77 bbl. 21.9°-gravity oil, perf. 2,190-2,200 ft., TD 4,563 ft., elev. 999 ft.

Orange County, Sunset Beach area: Algonquin Oil Co. 1 "Well," 29-5s-11w, flowed 60 bbl. 18.7°-gravity oil, perf. 4,446-89 ft., TD 4,639 ft., PB 4,500 ft., elev. 28 ft.

CALIFORNIA WILDCAT FAILURES

Butte County, Princeton area: H. H. Magee, Operator 2 Brady, 20-17n-1e, dry, TD 3,774 ft., elev. 62 ft.

Kern County, Devil's Den area: Robert Dopyera and M. V. Bartch 15 B. & D., 2-26e-18e, dry, TD 320 ft.

Mount Poso area: E. T. Willard 3 S. P., 3-27s-28e, dry, TD 830 ft., elev. 1,182 ft.

Santos Creek area: Independent Exploration 2 E-P USL, 4-29s-20e, dry, Buttonbed oil sand 450 ft., TD 1,074 ft., elev. 1,364 ft.

Kings County, Huron area: General Petroleum Corp. 48-7 B.L.C., 7-20s-19e, dry, TD 14,911 ft., elev. 280 ft.

Avenal area: O. M. Slosson 1 Reserve, 35-23s-17e, dry, TD 538 ft., elev. 1,190 ft.

Avenal Reef Ridge area: Reef Ridge Oil Co. 2 "Well," 10-23s-16e, dry, TD 1,400 ft., elev. 2,150 ft.

Santa Barbara County, Cuyama Valley area: Richfield Oil Corp. 1 Schaeffer, 20-10n-26w, dry, TD 8,630 ft., elev. 2,177 ft.

Orcutt area: Union Oil Co. 12 Hartnell, 22-9n-34w, dry, TD 7,347 ft., elev. 535 ft.

Ventura County, Simi area: Hancock Oil Co. 16-6 Strathearn, 6-2n-18w, dry, TD 3,466 ft., elev. 675 ft.

Temporary O.K. Issued

WASHINGTON.—A temporary certificate has been granted by the Federal Power Commission to Union Gas & Electric Co., Bloomington, Ill., for construction and operation of a 33-mile, 8-in. natural-gas pipe line in Illinois.

The line will run from Texas Illinois Natural Gas Pipe Line Co.'s system in Piatt County to Union's existing plant in Bloomington.

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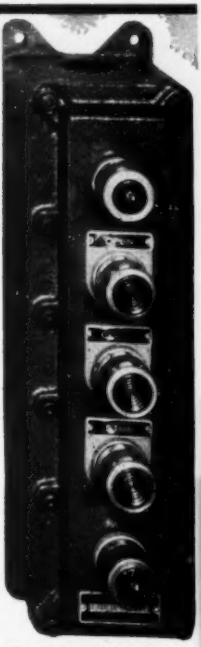

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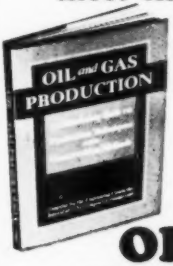

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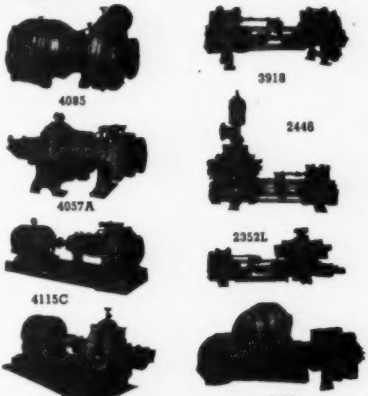

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Canadian Fields

Belloy Discovery Finds One Oil, Two Gas Pays

CALGARY.—Imperial Oil, Ltd., commenced production testing at its Belloy area hit in northwest Alberta and is preparing to start drilling at a step-out venture in the vicinity. The discovery well, Imperial-Belloy 2, in addition to striking natural gas and oil in the Jermo-Pennsylvanian sandstane, also found natural gas in two other horizons. During production tests, the well rated 30 -gravity crude oil between 75 and 80 bbl. daily. There was no water present with the oil which is coming from a thin pay section.

The Belloy discovery is located about 235 miles northwest of Edmonton and 45 miles southwest of Peace Riven town. The well's first discovery was natural gas, in the Nikanassin (Gething) formation. A drill-stem test from 2,976-98 ft. yielded gas at rate of 6,471,000 cu. ft. daily, and gave a pipe recovery of 10 ft. of gassy mud in 30 minutes.

The oil discovery came during a test of the Permo-Penn interval at 4,112-29 ft. During that 1-hour test, natural gas flowed at the rate of 125,000 cu. ft. daily, and pipe recovery was 540 ft. of oil. A second test in this zone, from 4,131-36 ft., recovered 2,720 ft. of salt water.

The third test at Belloy 2, was natural gas, which came from the Mississippian formation. Drill-stem tests in this horizon, between 4,644-4,877 ft., gave gas flow rates ranging from 443,000 cu. ft. to 2,048,000 cu. ft. daily.

The well was carried down to total depth of 8,264 ft., and 7-in. production string was set at 4,950 ft. Plugged back depth in the Permo-Pennsylvanian is 4,127 ft., and the interval at 4,117-23 ft. was perforated for production tests. During a 24-hour flow test, the well made 78 bbl. of clean oil. The hole was shut in for pressure tests, and is now on steady production making over 75 bbl. of oil daily.

Imperial-Belloy 2 is spotted in LSD 4, 20-78-1w6, 23 miles south southeast of Shell and B. A.'s Whitelaw oil and gas discovery, and 30 miles west southwest of Imperial-Normandville 1, Devonian oil discovery.

The new extension venture is Imperial-Belloy 3, in LSD 16, 25-78-1w6, about 5 miles northeast of Belloy 2. Imperial is moving one of its own rigs to the site for immediate drilling.

Formation water in the D3 has been found at the Canadian Superior Oil of California, Ltd.'s dual zone Devonian oil discovery well at New Norway, after encountering around 62 ft. of D3 oil-bearing water-free zone. That well also found a prolific D2 horizon, opening up between 95-100 ft. of water-free oil pay.

The discovery, Canadian Superior-Holt 15-36, in LSD 15, 36-44-22w4, about 3 miles southwest of Duhamel Devonian oil field, is located some 125 miles north northeast of Calgary. The latest D3 drill-stem test was run from 4,900-20 ft.; there was a strong steady blow, with natural gas reaching the surface in 5 minutes. One-hour pipe recovery was 4,175 ft. of fluid, consisting of 3,925 ft. of very muddy oil, 125 ft. of oily salt water and mud emuision, and 125 ft. of salt water. It is believed that the D3 water came in around bottom at 4,920 ft., thus indicating about 62 ft. of D3 oil pay. The D3 was contacted at 4,858 ft., or 2,359 ft. subsea. Coring is proceeding at the well.

The first follow-up ¼-mile south offset to the Bashaw D3 reef oil discovery well in central Alberta got assurance of commercial production this week, as a second drill-stem test in the D3 gave a flow of gas and oil to the surface. The well, being drilled by the team of American Leduc Petroleums, Ltd., and Yankee Canuck Oil & Mining Co. is Bashaw 2, in LSD 9, 31-41-22w4.

CANADIAN SUCCESSFUL WILDCATS

Imperial-Belloy 2, LSD 4, 30-78-1w6, TD 8,264 ft., 78 bbl. oil.

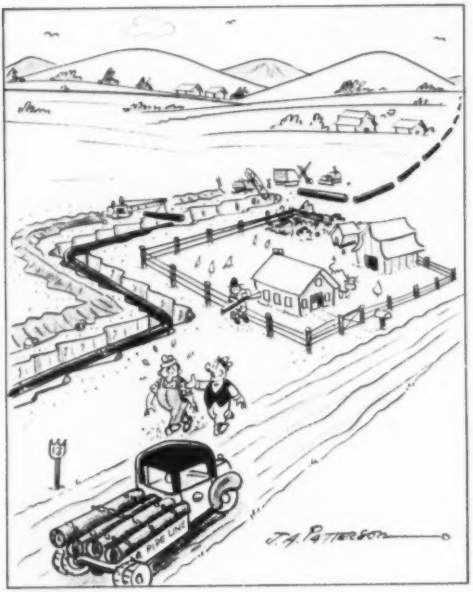
Dome-Naco-Drumheller 30-14, LSD 14, 30-29-19w4, TD 5,600 ft., 1,000 bbl. oil.

LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Washington 25, D. C. Notice is hereby given that two tracts of land totalling approximately 240 acres, in T. 29 N., R. 81 W., 6th P.M., Wyoming within the known geologic structure of the Bolton Creek field, will be offered for oil and gas leasing, through competitive bidding to the qualified bidders of the highest cash amounts per acre, at 1 p.m., Eastern Standard Time, October 31, 1951, when bids will be opened. The details of the lease offering and how and where to file bids may be obtained by addressing an inquiry to the Manager of the Land and Survey Office, Cheyenne, Wyoming, or to this office. Marion Clawson, Director.

LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Washington 25, D. C. Notice is hereby given that the W½NW¼ sec. 22, T. 57 N., R. 101 W., 6th P.M., Wyoming, within the known geologic structure of the Badger Basin field, will be offered in one parcel for oil and gas leasing through competitive bidding, to the qualified bidder of the highest cash amount per acre, at 1 p.m., Eastern Standard Time, October 31, 1951, when bids will be opened. Details of the lease offering and how and where to file bids, may be obtained by addressing an inquiry to the Manager of the Land and Survey Office, Cheyenne, Wyoming, or to this office. Marion Clawson, Director.



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It has been brought to the Company's notice that the Government of Iran in disregard of its solemn obligations to the Company, of the recent Order of the International Court of Justice, and of its international obligations, attempts to sell crude oil and oil products derived from the area covered by the Convention of 29th April, 1933.

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B.A.-South Calmar 6-2, LSD 6, 2-49-27w4, TD 6,202 ft., 1,761 bbl. oil.

CANADIAN WILDCAT FAILURES

Imperial-Alcomdale 1, LSD 14, 27-57-26w4, TD 5,779 ft., dry.

Homestead-North Canadian-Armena 1, LSD 15, 14-58-21w4, TD 3,331 ft., dry.

Amcan-Texaco-Beaverhill Lake 1, LSD 4, 27-51-17w4, TD 4,100 ft., dry.

Amerada-Stanolind Crown LF 24-9, LSD 3, 9-26-14w4, TD 3,750 ft., dry.

Naco-Airlines 1, LSD 8, 6-53-23w4, TD 5,410 ft., dry.

Red Deer-Leduc 1, LSD 16, 26-51-25w4, TD 4,120 ft., dry.

Amerada-Crown I.F. 2-27, LSD 12, 27-62-3w5, TD 3,669 ft., dry.

Canadian Delhi-Sun-Leckie 1, LSD 7, 25-20-17w4, TD 3,351 ft., dry.

Vanlorne 1, LSD 4, 9-50-25w4, TD 5,951 ft., dry.

Central Area

MICHIGAN

First offset to Croton field Traverse oil producer, Croton Township, Newaygo County, was under test this week at Busk & Ormiston 1 Mosher et al, NW SE NW 29-12n-11w. This new producer is the diagonal northeast 20-acre offset to the discovery well. Traverse lime was logged at 2,534 ft., some 7 ft. higher structurally than the objective at the discovery. The first oil started to show at 2,535-36 ft., and a good increase in oil and gas came in at 2,538-39 ft. The hole carried 1,900 ft. of fluid, natural, in 40 hours; 750 ft. were water. Operators planned to pump this well, natural, for a few days before acidizing.

Meanwhile Sun Oil Co. tested the Marshall section at the 1 Brown et al Unit, NW NW SW 29-12n-11w, the south 20-acre offset to the discovery. This well showed for 370,000 cu. ft. of gas a day, maximum gage, on a drill-stem test of the section from 896-901 ft.

Oil pipe-line outlets for Rose City and St. Helen Richfield oil pools, Ogemaw and Roscommon counties, were announced this week by two of Michigan's largest independent gatherers and transporters. Leonard Pipe Line Co. announced it had a 13.6-mile 4-in. line under construction from Rose City field to the company's West Branch terminal, which would be completed in about 10 days. Welded Construction Co. was awarded the contract for building this line.

Simrall Division, Roosevelt Oil & Refining Corp., announced that construction would start immediately on a combination 4 and 6-in. line from the two pools to Simrall's pumping station in East Norwich pool, Missaukee County. This line will be a 35-mile construction project. Mahoney Contracting Co. has been awarded the contract for construction, which is scheduled to be completed by mid-October.

MICHIGAN WILDCAT FAILURES

Allegan County, Ganges Township: W. D. Gannett 1 Gooding et al, NW NE SW 3-2n-16w, Traverse 1,375 ft., dry, TD 1,377 ft.

Ford Oil Co. 1 McKeown, SE SW NW 26-2n-16w, Traverse 1,194 ft., dry, TD 1,214 ft.

Martin Township: W. R. Swetland 1 Leep, NW SW NW 13-2n-11w, Traverse 1,670 ft., dry, TD 1,705 ft.

Salem Township: C. A. Johnson 1 Hutty, NE NE NW 35-4n-13w, Traverse 1,701 ft., dry, TD 1,798 ft.

Muskegon County, Montague Township: McClure Oil Co. 1 Wilkinson & Scholl, NE SE SW 18-12n-17w, Dundee 2,099 ft., dry, TD 2,110 ft.

Oceana County, Colfax Township: John Neyer 1 Ellis et al, W/2 NW NE 30-16n-15w, Traverse 2,052 ft., dry, TD 2,079 ft.

Van Buren County, Arlington Township:

R. T. Jones 1 Tomcala, SE SE SE 24-2s-15w, Traverse 1,070 ft., dry, TD 1,072 ft.
Bangor Township: Norman L. Stevens 1 Minardo, NW SW NW 3-2s-16w, Traverse 1,029 ft., dry, TD 1,034 ft.

ILLINOIS

Production of the Noble area of the Clay City-Noble Consolidated pool has been extended ¼ mile south and east where Perry Fulk and associates 2 Sparr, SW NE NE 35-4n-9e, flowed initially at the rate of 70 bbl. of oil per hour from Rosiclare lime at a total depth of 2,917 ft. Saturation was logged from 2,908 ft. Hole is open below 2,905 ft. The extension discovery is 6 miles west of Olney, in Richland County.

Stanford Oil Co. 1 School Board, NW NE NE 26-1n-3w, which opens another Devonian-Silurian producing area in southern Clinton County, just north of the Washington County line, swabbed 115 bbl. of clean oil in 10 hours before acidizing. Pay zone is at 2,600-11 ft. The area is 2 miles southwest of Posey and about 9 miles south of Carlyle. Drilling already is under way at a confirmation test, 2 School Board, NE NE NE 26, a location east of the discovery well.

This area is 10 miles to the southeast of the Frogtown North pool, opened last April, where the Devonian-Silurian horizon is proving an important source of production. In that pool, Gulf Refining Co. is completing another good well in that pay at its 2 Warnecke, E½ SW NW NE 6-2n-3w. This well, testing broken porosity from 2,225 ft. to 2,310 ft., flowed 567 bbl. of oil in the first 10 hours. It will be the eleventh well in the pool from that pay zone. It is a location southeast of Gulf's 1 Warnecke, the discovery well.

ILLINOIS SUCCESSFUL WILDCATS

Gallatin County: S. B. Griffith and Nathan Berkman 1 Hale, SW NW NE 21-7s-9e, IP 29 bbl., Cypress 2,605-20 ft., TD 2,620 ft. (southwest of Herald pool).

Wabash County: Gilliam Drilling Co. 1 Miller, NE NW SW 25-1n-14w, IP 306 bbl., O'Hara 2,840-44 ft., TD 2,844 ft., (southwest of South Lancaster pool).

ILLINOIS WILDCAT FAILURES

Bond County: J. L. Crawford 1 Harwood, NW SE SE 6-6n-3w, dry, TD 2,187 ft.

Christian County: The Texas Co. 1 Blakelev, NE NE NW 31-11n-1e, dry, TD 2,843 ft.

E. H. Kaufman 1 Sprinkle, NW NW NE 25-12n-1e, dry, TD 2,675 ft.

Clay County: Superior Oil Co. 1 Habbe, SW NE NE 12-5n-6e, dry, TD 2,891 ft.

Edwards County: National Associated Petroleum Co. 1 Allison, SE SW NW 8-3s-14w, dry, TD 3,150 ft.

Effingham County: Columbus Exploration Co. 1 Schome, SW NE SE 4-7n-5e, dry, TD 2,382 ft.

Hamilton County: C. E. Brehm 1 Allen, SE SE NE 24-4s-6e, dry, TD 2,576 ft.
Shulman Brothers 1 Harrelson, SW SE NE 16-6s-5e, dry, TD 3,359 ft.

Jefferson County: R. W. Edwards, Trustee, and T. M. Conrey 1 Hill, SW SW SW 19-1s-1e, dry, TD 1,993 ft.

Marion County: Sanders & Fye 1 Heinzmann, NE SE SW 30-3n-1e, dry, TD 3,068 ft.

Shelby County: W. F. Wooten and J. W. Rudy 1 Hill, SE SE SE 7-13n-2e, dry, TD 2,525 ft.

White County: E. F. Moran et al, 1 Pearce, NE NW SE 35-6s-10e, dry, TD 3,032 ft.

INDIANA

A new Biehl sand (Pennsylvanian) pool appears to have been uncovered by Indiana Farm Bureau at its 1 Phillips Community, SW NW SW 16-6s-11w, Vanderburgh County. The location is 2 miles west of Evansville. It is a mile east of other production in the Belknap pool and 1½ miles southwest of the Evansville pool. The well has 3 ft. of oil saturation at 1,520-23 ft. with bottom of the hole still in the pay. In a drill-stem test of the zone, the well got a fair showing of gas and filled 150 ft. of clean oil and 10 ft. of oil-cut mud. Casing has been run to 1,517 ft. for completion.

INDIANA WILDCAT FAILURE

Gibson County: Winmar Oil Co. 1 Kirk, NE NW SE 27-1s-10w, dry, TD 1,929 ft.

EASTERN KENTUCKY

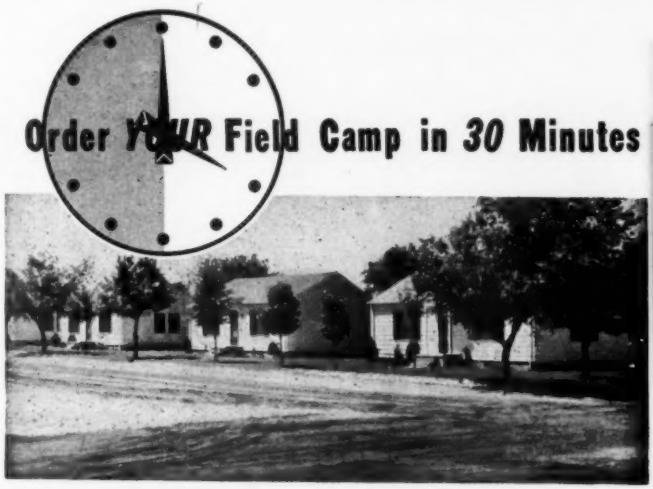
In Powell County, on the northeast end of Pilot pool, Sherman Hall completed 9 E. H. Fuller for 10 bbl. of oil daily from the Corniferous lime at a total depth of 876 ft. with a 4-ft. penetration of the pay. In the same pool, J. S. Miller completed 4 J. S. Abbott for 15 bbl. of oil daily from the Corniferous topped at 1,120 ft. and bottomed at 1,126 ft.

In the Knott County sector of Big Sandy gas field, Kentucky-West Virginia Gas Co. completed 6005 Hazel Collins on Carr Fork for 198,000 cu. ft. of gas daily from a Devonian black shale at a total depth of 3,460 ft. The well was shot with 5,200 lb. of gelatin.

In Lawrence County, on the northwest edge of production in Martha pool, Ashland Oil & Refining Co. completed 34 William Lester for 10 bbl. of oil and 15 bbl. of water daily from the Weir sand at a total depth of 1,013 ft. Lester 35 has rigged up and set 22 ft. of surface pipe.

WESTERN KENTUCKY

Iley B. Browning & Sons have completed their 2 Cottingham, McClosky lime discovery well in the active Knob Lick pool, Webster County. At completion, the well flowed 149 bbl. of oil per day through



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24/64-in. choke. Casing is perforated at 2,653-53 ft. Other wells in the pool produce from the Palestine, Waltersburg, Tar River and Hardinsburg sands. Principal development lately has been in the Hardinsburg sand, in which four additional wells are now in process of completion. There are four other active operations in the pool.

WESTERN KENTUCKY SUCCESSFUL WILDCAT

Henderson County: Nash Redwine 1 Alexander, 10-P-24, IP 32 bbl., Aux Vases sand 2,242-49 ft., TD 2,280 ft.

WESTERN KENTUCKY WILDCAT FAILURES

Daviess County: R. E. Stouder 1 Davis, SW NW SE 4-N-27, dry, TD 2,150 ft.

Henderson County: Noah Petroleum Co. 1 Robards, SE NE NE 9-O-24, dry, TD 2,490 ft.

Magnolia Petroleum Co. 1 Stewart, SW NE SW 9-Q-24, dry, TD 2,519 ft.

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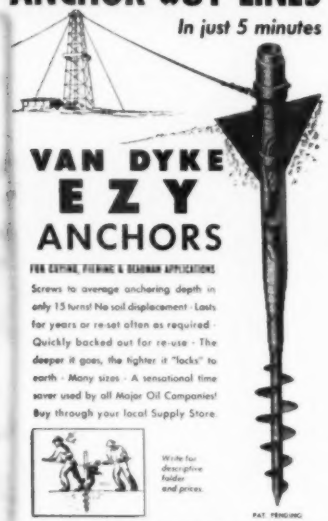

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Two Louisiana Areas Get Pay Confirmation

SHREVEPORT.—Production in the revived Beekman field of Morehouse Parish has been confirmed by Justiss Mears Oil Co. et al. 1 J. F. Albright, NE NE 6-22n-6e. This northeast offset to the revival well flowed 123 bbl. of 47°-gravity oil from perforations at 3,657-62 ft. The hole was cased with 5½-in. to bottom 3,700 ft. The pool was recently reopened by the same company's 1 Crossett Timber & Development Co.

The newly opened Lisemore Landing field, Concordia Parish, also got confirmation this week. H. L. Hunt et al. E-5 Fisher Lumber Co., C SW SW 15-6n-7e, flowed an estimated 125 bbl. of oil from perforations at 5,850-55 ft. Total depth is 6,500 ft.

Natural Gas & Oil Corp., which brought in the first oil production for Barksdale Air Force Base, gave the military reservation its first gas producer. The operator is preparing to perforate the 1 USA, Section 11-17n-12w, in the Jeter around 4,200 ft. and in the Sligo around 5,000 ft. The corporation's 7 USA, SW SW SE 12-17n-12w, opened oil production on the 2,060-acre lease in Bossier Parish about 3 weeks ago. This well and the 6 USA (same section) are producing 125 bbl. of oil per day. The 5 USA, 12-17n-12w, is in the process of completing as the third oil well. The 2 and 3 wells (Sections 12 and 6) are drilling at 5,400 ft. and 5,000 ft. respectively.

Along the eastern edge of northern Louisiana in Tensas Parish, Justiss Mears will drill a Wilcox test in C NW NW 36-10n-9e. The new venture will be 1 J. D. Dale, located 1 mile northwest of Lake St. John production. In the same parish, Petersen Drilling Co. et al. will drill into Tuscaloosa zones at 1 Desha Lumber Co., C SW NE 10-13n-10e. This is a rank wildcat north of the town of Newlight.

Arkansas.—A new pool for Miller County is indicated at Skelly Oil Co. 1 Agnes Philyaw, spotted a little over a mile northwest of Northeast Fouke field, discoverd this year by the company's 1 Lane, Section 28-16s-26w. The new test, NW NW SW 19-16s-26w, recovered 1,880 ft. of 30°-gravity oil, 240 ft. of oil cut with salt water, and 500 ft. of salt water on a 1-hour test at 3,554-60 ft. Another drill-stem test at 3,832-42 ft. recovered 90 ft. of mud, 420 ft. of salt water cut with heavy black oil, and 2,970 ft. of salt water. Drilling is continuing toward contract depth of 5,500 ft.

Slightly over a mile northeast of a Smackover dry hole drilled to 9,965 ft. (Barnsdall et al 1 Bodcaw Oil Co., 8-18s-23w), California Co. is rigging up at the 1 P. D. Burton, Jr., et al, C NE NE 9-18s-13w, Lafayette County. This new deep Smackover test is slated to go to 9,700 ft.

NORTH LOUISIANA SUCCESSFUL WILDCAT

Caddo Parish: Butler-Johnson Well Service, Inc. 1 Sentell, 1,042 ft. S and 3,186 ft. E NWc 35-19n-14w, 16,000,000 cu. ft. gas from Bodcaw sand (Cotton Valley) at 8,324-46 ft., TD 8,352 ft., opens Sentell pool.

NORTH LOUISIANA WILDCAT FAILURES

Concordia Parish: Hunt Oil and Gulf Refining 3 Angelina Hardwood Lumber Co., C SW NE 26-4n-7e, dry, TD 7,504 ft.

Devonian Oil 1 Magee - Evans - Junkins, SEc 43-6n-9e, dry, TD 7,020 ft.

Grant Parish: W. L. Baker et al 1 International Paper Co., 1,960 ft. S and 4,650 ft. E NWc 33-8n-3w, dry, TD 5,074 ft.

LaSalle Parish: Carter Oil 1 Delta Land Co., C NW SE 14-6n-4e, dry, TD 6,015 ft.

Madison Parish: McAlester 1 Marston "A," C NW SW 19-16n-10e, dry, TD 5,026 ft.

ARKANSAS SUCCESSFUL WILDCATS

Miller County: Stanolind Oil & Gas 1 Miller Land & Lumber Co., C NW SE 20-18s-27w, 62 bbl. condensate from Rodessa Hill sand at 6,056-65 ft., TD 6,519 ft., recompletion of Ft. Lynn discovery.

Union County: Murphy Corp. 1 Robertson "A," C SE NE 33-18s-14w, 18 bbl. oil from Travis Peak at 3,620-26 ft., TD 4,006 ft.

ARKANSAS WILDCAT FAILURE

Union County: Vaughn Producing Co. 1 C. E. Smith, 100 ft. E of C NE NE 28-17s-18w, dry, TD 7,623 ft.

Mid-Continent Transfers Kenyon to New Sales Post

J. H. KENYON

Ken W. Davis, president and general manager of Mid-Continent Supply Co. has announced the transfer and appointment of John H. Kenyon, former sales engineer at Wichita Falls, Tex., to the Fort Worth machinery department as sales engineer. Kenyon joined Mid-Continent in 1947 in the machinery department at Fort Worth. The same year he was transferred to Shreveport, where he was in charge of machinery sales and then was transferred to Wichita Falls as a machinery sales engineer.

OIL FIELD TRAILERS

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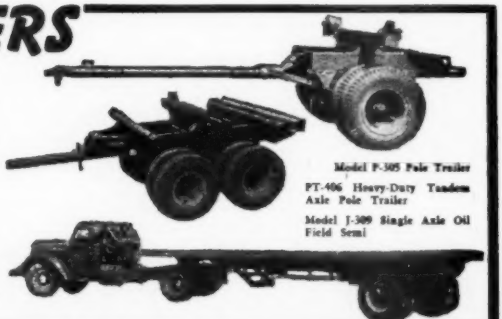
Spencer-Safford LOADCRAFT INC.
AUGUSTA, KANSAS
SUCCESSORS TO SPENCER TRAILER CO.
ESTABLISHED 1916

Phone 82, Augusta, Kansas, or wire Spencer-Safford Loadcraft for detailed information on pole type, flat beds or vans.



Model P-305 Pole Trailer
PT-406 Heavy-Duty Tandem Axle Pole Trailer
Model J-309 Single Axle Oil Field Semi

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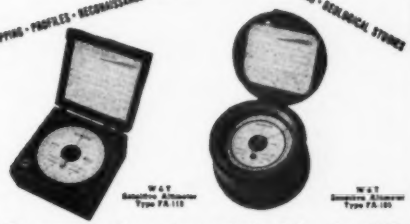

The reasons for the growing popularity of these dependable instruments are not hard to find. Here are a few highlights:

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Self-balancing Principle: No adjustment or setting is required and the altimeter is always in balance with the atmosphere and ready to read. There is no lag.

Calibration: Scales are individually drawn for each mechanism and require no correction. Graduations are spaced for easy readability and not so fine as to cause confusion.

Durability: The mechanism is simple and free from intricate design features. For complete protection it is shockproofed in the instrument case.

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BALL BEARING SWIVEL FITTINGS
FOR LIQUIDS, GASES, STEAM, AND OTHER CHEMICALS. HOT OR COLD SERVICE. CONTINUOUS OR OCCASIONAL ROTATION SERVICE.

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Send for complete catalog and prices. State kind of service, pressure, temperature, pipe size and indicate style at left, threaded, flanged or weld ends.

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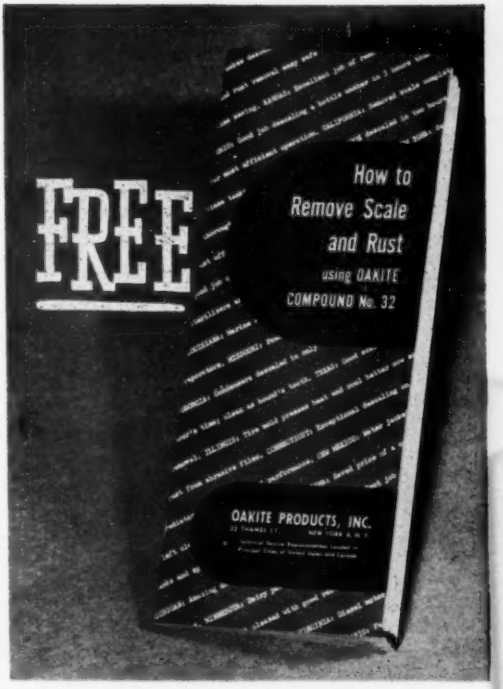
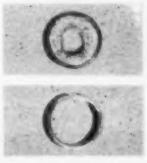
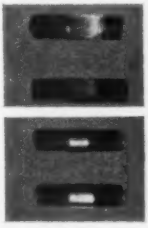
HOLLYDALE, CALIFORNIA

RAMSCO





Section of pipe before and after descaling with Oakite Compound No. 32



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PETROLEUM SERVICE DIVISION

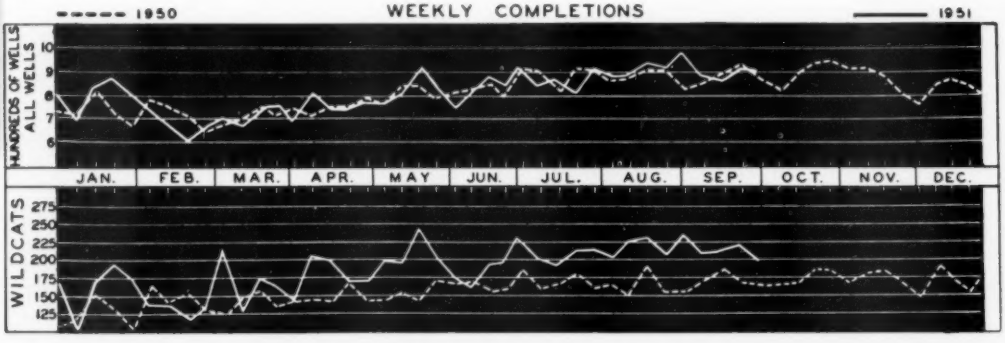
CURRENT STATISTICS

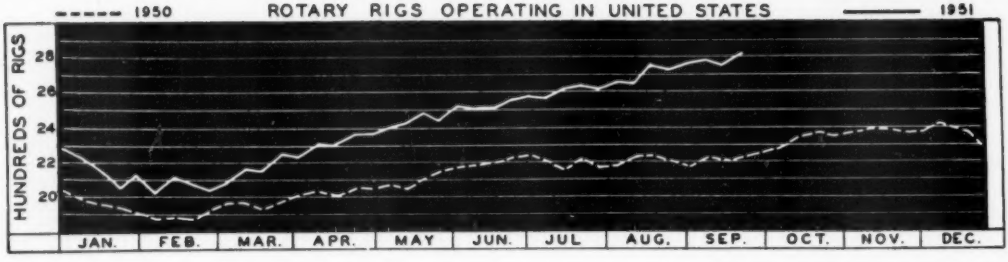
EXPLORATION

WEEKLY WELL COMPLETIONS . . . WEEK ENDED SEPTEMBER 29, 1951

	Total of all wells					Sept. 29		Wildcat completions and discoveries									
													Cumulative total, 1951				
	Comp.	Oil	Gas	Dry	Footage	1951	1950	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	16	7	0	*9	23,520	487	524	0	0	0	0	0	0	0	0	0	0
Pennsylvania	37	19	8	†10	67,291	1,083	1,014	0	0	0	0	0	0	0	0	1	1
West Virginia	19	7	7	5	45,057	433	496	0	0	0	0	0	0	0	9	6	15
Ohio	18	8	5	‡5	45,226	711	759	0	0	0	2	2	1	0	5	18	24
Indiana	29	16	0	13	56,916	961	1,192	0	0	0	1	1	34	0	1	264	299
Kentucky	22	9	4	9	48,025	897	834	1	0	0	3	4	20	0	1	115	136
Illinois	40	12	0	28	111,824	1,758	2,056	2	0	0	12	14	58	0	0	411	469
Michigan	15	4	0	‡11	29,378	578	655	4	0	0	3	7	21	0	7	221	249
Kansas	73	36	8	29	251,041	3,261	2,888	2	0	0	9	11	158	1	13	645	817
Nebraska	4	1	0	3	18,388	170	83	0	0	0	2	2	7	0	1	85	93
Oklahoma	96	46	13	‡37	371,731	4,160	4,029	2	0	0	11	13	141	4	17	539	701
Texas	349	219	19	111	1,585,572	12,423	12,234	19	2	5	63	89	553	43	90	2,558	3,244
North Central (Dist. 7-B & 9)	114	50	1	§54	355,287	3,778	3,694	11	0	0	31	42	267	2	12	1,098	1,379
West (Dist. 7-C & 8)	95	79	0	16	542,196	3,766	3,688	5	0	0	9	14	136	9	6	479	630
Panhandle (Dist. 10)	14	8	5	1	43,055	522	689	0	0	0	1	1	2	0	0	18	20
Eastern (Dist. 5 & 6)	23	18	0	5	143,788	899	863	0	2	0	2	4	9	8	0	178	195
Gulf Coast (Dist. 2 & 3)	50	23	8	19	283,102	1,711	1,710	0	0	2	13	15	71	16	45	356	488
Southwest (Dist. 1 & 4)	53	32	5	16	218,144	1,747	1,590	3	0	3	7	13	68	8	27	429	532
Louisiana	43	27	2	14	290,079	1,568	1,834	0	0	1	8	9	31	8	7	213	259
Northern	26	15	2	9	116,783	853	985	0	0	1	5	6	9	0	4	128	141
Southern	17	12	0	5	173,296	715	849	0	0	0	3	3	22	8	3	85	118
Arkansas	15	8	0	7	65,428	304	309	1	1	0	1	3	12	1	3	61	77
Mississippi	11	1	0	10	73,039	262	239	0	0	0	8	8	12	3	0	106	121
Southeastern States	4	0	0	4	31,419	43	46	0	0	0	4	4	0	0	0	20	20
Montana	2	0	0	2	5,644	163	187	0	0	0	2	2	0	0	0	37	37
Wyoming	18	10	0	8	95,073	553	427	1	0	0	8	9	8	0	1	91	100
Colorado-Utah	9	6	1	2	44,894	207	64	0	0	0	1	1	7	0	4	97	108
New Mexico	28	10	14	4	146,184	498	466	1	0	1	1	3	16	0	8	54	78
California	56	45	0	11	212,738	1,711	1,334	3	0	0	10	13	38	0	4	340	382
Miscellaneous (Md.)	3	0	1	2	13,775	59	41	0	0	1	2	3	1	0	20	22	43
Total United States	907	491	82	334	3,632,242	32,290	31,711	36	3	8	151	198	1,118	60	191	5,904	7,273
Total previous week	920	466	71	383	3,628,968			29	2	3	187	221	1,082	57	183	5,753	7,075
Total September 29, 1950	872	491	53	328	3,180,969			20	2	4	138	164	827	56	155	4,736	5,776

Service wells included: *9, †10, ‡1, §3.





DAILY AVERAGE PRODUCTION FOR WEEK

	Sept. 29 crude oil	B. of M. Sept. demand	Sept. 22 crude oil
Alabama	3,050	2,400	3,050
Arkansas	77,250	84,000	77,050
California	982,700	975,000	982,300
Colorado	78,100	77,000	77,100
Eastern	58,100	62,000	59,200
Florida	1,700	1,600	1,675
Illinois	167,600	160,000	164,200
Indiana	30,900	29,000	31,200
Kansas	330,150	320,000	329,750
Kentucky	32,000	29,000	31,900
Louisiana	625,750	668,000	625,450
North Louisiana	112,850		112,550
South Louisiana	512,900		512,900
Michigan	40,900	40,000	36,800
Mississippi	98,750	102,000	97,800
Montana	24,500	25,000	25,000
Nebraska	7,350	8,000	6,400
New Mexico	145,575	154,000	145,575
Oklahoma	504,950	530,000	505,700
Texas	2,827,600	2,690,000	2,827,600
Dist. 1 (Southwest)	33,575		33,575
Dist. 4 (Southwest)	259,450		259,450
Dist. 2 (Gulf Coast)	166,475		166,475
Dist. 3 (Gulf Coast)	486,675		486,675
Dist. 5 (Eastern)	57,100		57,100
Dist. 6 (Eastern)	117,950		117,950
East Texas field	227,200		227,200
Dist. 7-C (West)	108,350		108,350
Dist. 8 (West)	992,925		992,925
Dist. 7-B (W. Central)	83,600		83,600
Dist. 9 (N. Central)	159,550		159,550
Dist. 10 (Panhandle)	84,750		84,750
Utah	3,800	5,000	3,800
Wyoming	189,200	178,000	190,900
Total United States	*6,229,925	6,140,000	6,222,450
Change from previous week, up	7,475		
Canada	177,000		181,525

Total U. S. production January 1-September 29 †1,657,603,745 bbl.
Same period last year (crude plus cond.) 1,436,393,095 bbl.

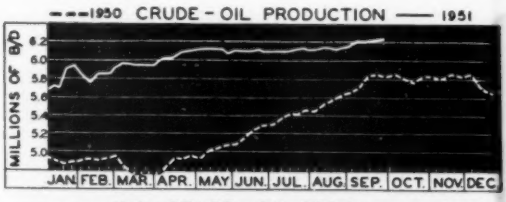
*Not including 103,055 bbl. condensate. †Including 28,551,180 bbl. condensate.

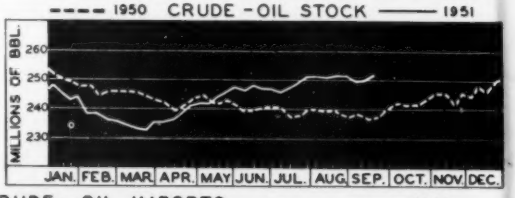
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

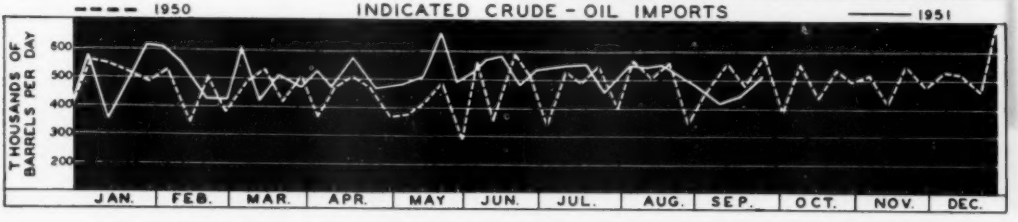
(Thousands of barrels)

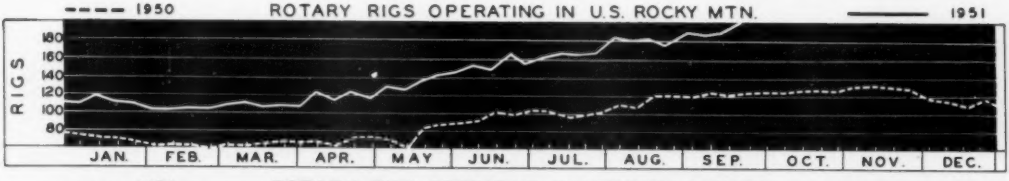
	Sept. 22, 1951	Sept. 15, 1951	Sept. 23, 1950
Pennsylvania Grade	2,102	2,167	2,395
Other Appalachian	1,668	1,561	1,313
Illinois, Indiana, Michigan	12,962	12,388	9,611
Arkansas	2,869	2,713	2,916
Louisiana	15,397	14,633	14,225
North	2,580	2,685	3,218
Gulf	12,817	11,948	11,007
Mississippi	3,160	3,251	2,617
New Mexico	6,826	6,572	6,408
Oklahoma and Kansas	38,409	38,342	35,257
Texas	118,917	118,760	117,399
East Texas	14,329	14,792	13,678
West Texas	49,995	50,299	48,150
Texas Gulf	26,331	26,342	28,454
Other Texas	28,262	27,327	29,117
Rocky Mountain	13,125	13,110	10,432
California	30,030	30,050	30,719
Foreign	7,104	6,943	6,349
Total	252,569	250,490	239,641

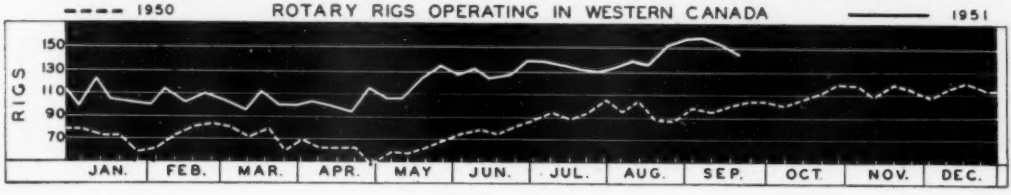
*Bureau of Mines.











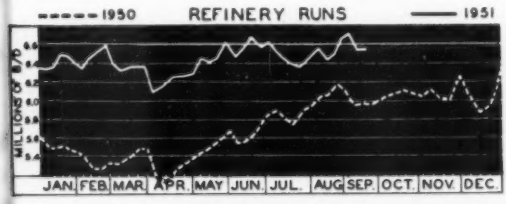
A.P.I. REFINERY REPORT, SEPTEMBER 22

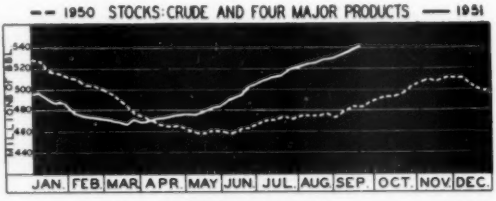
(Thousands of barrels)

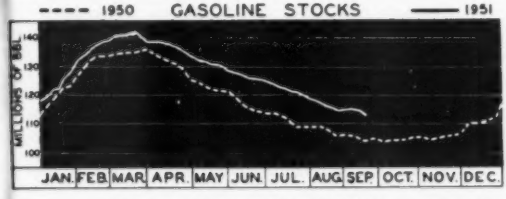
District—	Daily avg. crude runs	Daily average production: Gasoline*	Kerosine	Distillate	Residual	Stocks at refineries, bulk terminals, in transit and in pipe lines: Gasoline†	Kerosine	Distillate	Residual
East Coast	1,074	442.1	53.6	277.9	209.1	24,053	12,108	32,147	11,640
Appalachian:									
District 1	103	46.3	6.0	14.1	10.9	2,762	639	1,080	589
District 2	73	39.0	3.9	12.6	12.9	1,546	336	447	274
Ind., Ill., Ky.	1,151	598.7	75.0	192.4	138.8	24,274	7,630	20,838	5,804
Okla., Kans., Mo.	540	294.2	17.8	130.6	61.1	11,880	1,911	11,147	1,926
Inland Texas	254	170.7	15.4	42.0	42.7	3,764	616	1,709	1,199
Texas Gulf Coast	1,567	715.7	104.0	373.4	239.6	18,070	5,623	11,853	6,710
La. Gulf Coast	500	247.9	45.7	122.9	63.6	5,818	2,975	3,927	2,384
N. La. and Ark.	65	27.3	4.9	10.4	8.3	3,077	627	1,016	187
Rocky Mountain:									
New Mexico	13	6.7		2.6	3.7	110		61	35
Other Rocky Mtn.	230	104.4	7.0	42.9	42.0	3,691	441	2,159	1,122
California	980	414.4	8.6	142.1	361.3	14,027	623	8,780	15,774
September 22, 1951	6,550	3,107.4	341.9	1,363.9	1,194.0	113,072	33,529	95,164	47,644
September 15, 1951	6,544	3,102.9	365.4	1,261.9	1,228.3	114,318	32,945	92,528	47,972
September 23, 1950	5,982	2,818.0	336.4	1,116.6	1,193.7	104,739	27,632	75,079	42,319

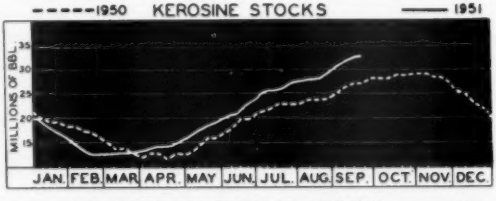
Bureau of Mines, September 1950	Daily avg. crude runs	Daily average production: Gasoline*	Kerosine	Distillate	Residual
	983	386.5	43.9	219.2	219.8
	105	46.2	6.3	11.9	10.1
	73	35.5	4.8	8.4	14.6
	993	512.7	59.7	166.4	141.5
	510	287.4	17.3	119.1	55.5
	212	149.2	10.5	32.1	34.6
	1,473	664.8	111.3	322.0	259.0
	496	237.1	56.7	115.2	62.9
	78	28.2	8.2	17.4	8.8
	13	7.0	.4	2.2	3.2
	195	87.5	4.9	37.4	34.4
	928	406.5	9.0	128.4	333.7
	6,059	2,848.6	333.0	1,179.7	1,178.1

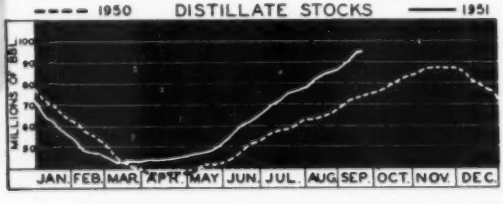
*At refineries including natural blended. †Finished and unfinished.

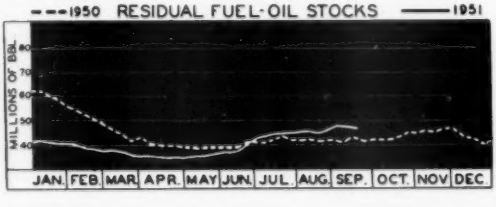


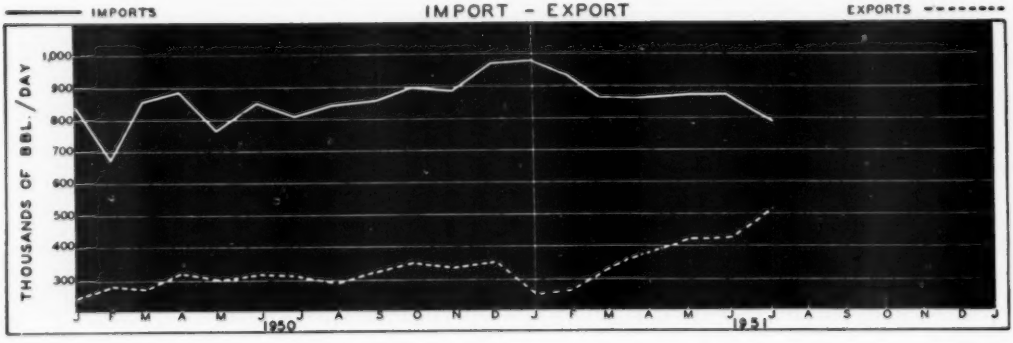












CRUDE PRICES
GRAVITY SCHEDULE

	Signal Hill, Calif.‡	Oklahoma, Kansas	Gulf Coast Tex.*	West Tex.†
18-18.9	$1.93			
19-19.9	1.98			
20-20.9	2.03	$2.25		$2.12
21-21.9	2.07	2.27		2.14
22-22.9	2.12	2.29		2.16
23-23.9	2.18	2.31		2.18
24-24.9	2.24	2.33	$2.56	2.20
25-25.9	2.30	2.35	2.58	2.22
26-26.9	2.36	2.37	2.60	2.24
27-27.9	2.41	2.39	2.62	2.26
28-28.9	2.46	2.41	2.64	2.28
29-29.9	2.52	2.43	2.66	2.30
30-30.9	2.57	2.45	2.68	2.32
31-31.9	2.62	2.47	2.70	2.34
32-32.9	2.68	2.49	2.72	2.36
33-33.9		2.51	2.74	2.38
34-34.9		2.53	2.76	2.40
35-35.9		2.55	2.78	2.42
36-36.9		2.57	2.80	2.44
37-37.9		2.59	2.82	2.46
38-38.9		2.61	2.84	2.48
39-39.9		2.63	2.86	2.50
40 and above		2.65	2.88	2.52

*For crude from Daboval, El Campo, and Sand Point.

†Includes Lea County, New Mexico. Last general price change represented a 50-cent increase becoming effective December 6, 1947.

‡Standard Oil Co. of California.

FLAT CRUDE PRICES

Representative posted schedules per barrel	
East Texas†	$2.65
Kettleman Hills, California*	2.80
Beauregard Parish	2.60
Illinois Basin	2.77
Pecos County, Texas (Yates)	2.35
Bradford, Pennsylvania	4.25
Eastern Ill. and Western Ind.†	2.77
Tomball, Texas Gulf Coast	2.83

*37°-37.9°. †35° and above.

AT the end of September residual fuel represented the softest part of the Group 3 market. The railroads in the area paid $1.75 a barrel in September, and refiners with formal postings were quoting the same price. However, there has been an increasing number of reports of under-the-market sales for the past few weeks. Since most of the offers of residual at prices under the "low" are for relatively small quantities, the resulting softness of the market may be due to distress material from suppliers whose total volume is too small to lower the general heavy-fuel market.

Trends in the Group 3 market indicate that most Mid-Continent refiners are expecting record demands for residual in District 2 this winter and are offering at this time only minimum amounts to balance storage. Sales of natural gas to large industrial consumers at summer rates will be discontinued earlier than last year. Since most of this gas will be replaced by residual fuel, stocks of heavy fuel in District 2 may start down in October.

District 2 residual inventories on September 22 amounted to 8,004,000 bbl., down 109,000 bbl. for the week but up 1,959,000 bbl. from same date last year. Most of the dirty cars in asphalt service will be available before the end of this month, but unless all cars are used early in the season to move residual as near as possible to points of consumption, there will be a shortage of cars during the winter months. Stocks were too low last year, and many consumers in the upper areas of District 2 were able to meet their needs only through purchases from refineries located deep in Texas. Long rail hauls added to the delivered cost of the product and helped create the dirty-car shortage. These distribution problems can be avoided if consumers will fill their tanks and keep them filled in the early part of the season.

REPRESENTATIVE QUOTATIONS

Representative spot-market quotations of leading suppliers as of October 1, 1951. Figures are f.o.b. plant for tank-car shipments in cents per gallon, except for residual fuel oil which shows the price per barrel and wax, in cents per pound.

GASOLINE, KEROSINE, AND FUEL OILS

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor (barge)	Texas Gulf Coast
Regular gasoline, 80-82 octane	10¼-10½	12-12.75	10¾-11
Premium gasoline, 86-88 octane	11¼-11½	13.5-13.75	11¾-12
42-44 w.w. kerosine	9-9⅜	10	9
No. 2 straw fuel oil	8-8⅜	9	8
No. 6 residual	$1.70-1.80	$2.45-2.60	$1.75-1.90

NATURAL GASOLINE

	Group 3	North Texas	N. La.
Grade 26-70	6⅝	7⅜	6⅛
Grade 18-55	7.65	7.15	7.40

LUBRICATING OILS

South Texas

200 vis., No. 2-3 neutral	13-13.5
750 vis., No. 3-4 neutral	16
2,000 No. 5-6 neutral	18-19

LUBRICATING OILS

Mid-Continent

150-160 vis., D bright stock, 0-10 pp.	29-30
200 vis., No. 3 neutral, 0-10 pp.	17.5-18.5

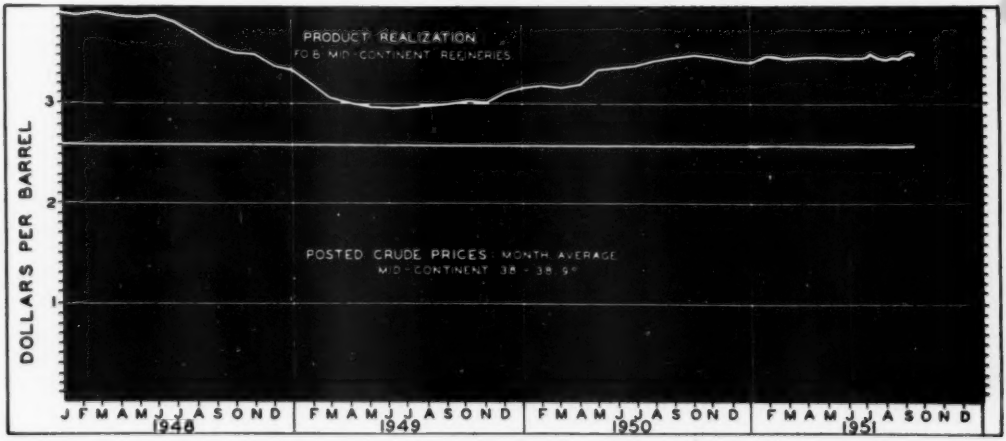
Western Pennsylvania

145-155 vis., 10 p.t. bright stock	32.5
180 vis., 0 p.t. neutral	31.5

WAX

Mid-Continent

132-134 A.M.P.	6.0


PRODUCT REALIZATION
F.O.B. MID-CONTINENT REFINERIES
POSTED CRUDE PRICES: MONTH AVERAGE
MID-CONTINENT 38 - 38.9°
DOLLARS PER BARREL
3
2
1
J F M A M J J A S O N D
1948
J F M A M J J A S O N D
1949
J F M A M J J A S O N D
1950
J F M A M J J A S O N D
1951

In this trend chart refinery realization is based on average Mid-Continent grade crude oil (not 38° gravity only) and average prices for refinery products as published in The Oil and Gas Journal basis Oklahoma (Group 3). Refinery yields confined to gasoline, kerosine, distillate, and fuel oil. Realization averaged $3.53 for week ended September 22, $3.54 for previous week, and $3.51 for September 1950.

EQUIPMENT MEN . . . in the News

Weco Announces New Appointments

J. C. McCELVEY

John W. Gates, sales manager for Well Equipment Manufacturing Corp., Houston, has announced the transfer of J. C. McCelvey and L. L. Durkin to New Mexico-West Texas territory as sales representatives for the company.

L. L. DURKIN

H. T. ROGERS

McCelvey, associated with Weco for 13 years, has had various manufacturing and sales assignments. For the past 3 years he was Weco sales representative on the Gulf Coast. McCelvey will serve the West Texas territory with headquarters in Odessa.

L. L. Durkin, who will make his headquarters in Hobbs, N. M., will serve southeast New Mexico and part of West Texas. During his 2 years with Weco Durkin has had several manufacturing and service assignments, in addition to his sales work in the Ark-La-Tex territory from where he was transferred to New Mexico.

Another Weco release announced the appointment of Harry T. Rogers as sales representative for East Texas, North Louisiana, and southern Arkansas. Rogers has been assigned to sales after a period of service in the Weco plant and upon completion of its training program.

Continental Supply Makes Changes in Personnel

The Continental Supply Co. has made the following personnel changes:

Waif Strain, warehouseman and pump repair man at Lindsay, Okla., transferred to Russell, Kans., as store manager; N. K. Keller, manager at Kermit, Tex., transferred to Snyder, Tex., in the same capacity; Conley H. Sims, manager at Monahans, Tex., transferred to Kermit, Tex., in the same capacity; Roy A. Henley, floorman at Monahans, Tex., appointed store manager at the same location; Tommy B. McClelland, assistant store manager at Eunice, La., made store manager at the same location; and J. I. McQuiddy, salesman at Kilgore, Tex., transferred to Casper, Wyo., district office as manager of production equipment sales.

T. E. Levi Organizes Northwest Mapping Co.

Thomas E. Levi has resigned from Zingery Map Co., Houston, to open Northwest Mapping Co. at Bismarck, N. D. This newly formed company will cover the Williston basin and surrounding areas.

Levi studied engineering and geology at University of Houston, and he was manager of the Zingery interests in Texas, Louisiana, and Mississippi areas prior to resigning his post.

Kneubuhl Assumes New Duties at Fluor Corp.

James P. Kneubuhl, assistant manager of sales for Fluor Corp., Ltd., Los Angeles, has also assumed the duties of district sales manager of the company's New York office.

J. P. KNEUBUHL

Kneubuhl joined the firm in 1941 as an assistant project engineer. In 1944 he became advertising manager, holding that position until 1946 when he joined the sales department.

Hopkins Joins Associated

Associated Oil Field Rentals, Inc., has announced the appointment of R. F. (Hop) Hopkins as assistant manager of its main office and yard in Houston, as well as its branch yards.

Hopkins was formerly associated with American Iron & Machine Works, Oklahoma City.

Fluid Packed Pump Co. Increases Sales Force

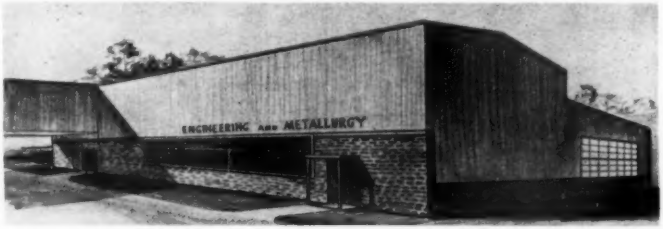
Sidney Shuman, general sales manager for Fluid Packed Pump Co., has announced four additions to the company sales force.

Ray C. Green, formerly of the British-American Oil Producing Co., has been named district representative at Duncan, Okla. Ray Housley has been transferred from El Dorado, Kans., to Seminole, Okla.; and Robert V. Holton has been stationed at El Dorado. David Russell, Jr., formerly of Oil Well Supply Co., has been appointed district representative at El Dorado, Ark.

New Warehouses Opened

Petroleum Distributing Co., Houston, distributors of oil-field petroleum products, and Jimmy Gray Tool Joint and Drill Collar Compounds, announce the opening of two additional warehouses at Williston, N. D., and Lovington, N. M.

Work Starts on New Cameron Iron Building



Construction is now under way on a new two-story engineering and metallurgical building for Cameron Iron Works, Inc., Houston. It is scheduled for completion during November. The front half of the building will house the offices, drafting rooms, and laboratories of the engineering and metallurgical departments, and the rear half will include the engineering-test labs, the stress-analysis lab, and the metallurgical machine shop.

BJ Announces Future Changes in Management

E. S. Dulin, president of Byron Jackson Co., has announced the following changes in management, to be effective in the near future:

Robert T. Harcus, executive vice president and general manager of International Cementers, Inc., will be assistant to the president; John B. Merritt, general manager of the Patterson-Ballagh Division, will be general manager

R. T. HARCUS

J. B. MERRITT

J. T. WORKMAN

of International Cementers, Inc., and James T. Workman, assistant to the president, will be general manager of Patterson-Ballagh Division.

Harcus became associated with Burmah Oil Co., Ltd., in 1922, and spent 23 years in India and Burma as fields superintendent and prospecting fields manager. He became affiliated with Byron Jackson as export representative in 1945. In 1947 he undertook the development of the jet process of perforating for Byron Jackson and remained in this capacity until 1949 at which time he went to International Cementers, Inc., as executive vice president and general manager.

Merritt became associated with Byron Jackson in 1940 as an employe in the production department. In 1947 he was made assistant to J. C. Ballagh, vice president and general manager of Patterson-Ballagh. Merritt became general manager at the time of Ballagh's retirement in 1949.

Workman joined Byron Jackson in 1946 as assistant to the vice president in charge of production until 1948 at which time he became assistant to the president.

Lincoln Electric Co. Moves Into New Plant

Lincoln Electric Co., Cleveland, recently moved all executive and plant offices to its new plant headquarters at 22801 St. Clair Avenue, Cleveland.

Pin-point planning made the move a smooth operation, with production on each machine picking up at the new plant a few hours after stopping at the old.

The move of the company's machine division, now complete, has involved tons of material and some 1,500 machines. Work has begun on moving out the electrode division which will complete the transfer of all operations into the new plant.

Dowell Announces New Engineering Promotions

Several employes of Dowel Incorporated have been promoted to new positions in the organization.

In the general office in Tulsa, James Reed has been made development engineer in the service and product-development department, and Roy Bostick has been promoted to sales-development engineer in the sales department.

Paul S. Clinkenbeard and Dale Benefield at Shreveport have been named district sales engineer and sales engineer respectively.

The following employes in the Edmonton, Alta., Canada office have received promotions: William Stemp, area development engineer; Spence Lawrence, office manager; William Wedderburn and Lewis McCabe, service supervisors, and A. E. Thorson, and Wallace Thorvaldson, sales engineers.

Franks Names Pitezel to District Sales Post

W. G. PITEZEL

W. G. (Bill) Pitezel, sales coordinator of Franks Manufacturing Corp., Tulsa, has been appointed Oklahoma district sales manager, according to Carl White, Jr., president.

Pitezel has been affiliated with Franks for 10 years during which time he worked in the shop as well as various positions in the sales department.

Flexitallic Adds to Field Organization

Flexitallic Gasket Co., Camden, N. J., recently announced the addition of six new agents and one new distributor to its field organization. They are: Jno. D. Hiles Co., Inc., Pittsburgh, for western Pennsylvania and eastern Ohio and portions of West Virginia; Engineering Products Co., Charleston, W. Va., for West Virginia, eastern Kentucky, and part of Ohio; Chapman Engineering Sales

Engineers Attend Pump Tests at United Centrifugal

Engineers from five major pipe-line companies were among those on hand July 27 at the Oakland, Calif., plant of United Centrifugal Pumps for official tests of the first of the eight largest pumps ever built for operation on U. S. pipe lines. The pumps will be installed on Texas Pipe Line Co.'s Basin Line at Hamlin and Seymour, Tex., and Comanche and Norman, Okla. Shown are, rear row: D. DiGrazia, United shop foreman; John Re, United sales manager; Roy Olbrich, acting assistant chief engineer for Texas Pipe Line Co.; and B. S. Booth, United president. Second row: Jack Henrich, chief electrician for United; Clayton Nehring, United test engineer; D. A. Pronzato, assistant chief engineer for United; Lawrence J. Viale, assistant sales manager for United; Roland Poinsett, assistant general manager for United; D. J. Condit, United representative from Tulsa; L. F. Scherer, assistant general manager of The Texas Pipe Line Co., Gray I. Morriss, United's Houston representative; Gene Hunt, Service Pipe Line Co. engineer; S. L. Westlake, assistant chief engineer for Magnolia Pipe Line Co.; P. D. Phillips, chief engineer, Humble Pipe Line Co.; H. A. Johns, assistant chief engineer, West Texas Gulf Pipe Line Co.; and Val Lobanoff, chief engineer for United. Front row: J. Hotz, United's assistant superintendent; Tom Goodwin, United's superintendent, and Harold Booth, vice president, United Centrifugal Pumps.

Co., Cincinnati, for southwestern Ohio and northern Kentucky; De Haven Engineering Co., Indianapolis, for Indiana and western Kentucky; Steel & Engineering Products Co., El Paso, Tex., for southwestern Texas, southern New Mexico, and Arizona; and Energy Control Corp., Philadelphia, for eastern Pennsylvania, southern New Jersey and Delaware.

Fleck Bros., Ltd., Vancouver, B. C., will serve Flexitallic as distributor in the western provinces of Canada.

Pelton Announces New Odessa Office

C. J. WOODARD

C. J. Woodard, manager of the oil - industry - machinery division of Pelton Water Wheel Co., Los Angeles, has announced the opening of a new Odessa, Tex., office. Complete parts and warehouse facilities, as well as 24-hour service, are being maintained.

Managing the Odessa office is Earl Dwyer, formerly Los Angeles plant office manager. Also assigned to the Odessa staff is Gene Bell, who will work with Dwyer on sales and service. Bell has been active in West Texas oil fields for 15 years.

Other Pelton Mid-Continent sales and service headquarters are maintained in Dallas and Houston.

Tears Engineers to Design, Construct Process Plants

Tears Engineers, Dallas, is a new firm established to handle complete engineering projects in the process industries. The organization specializes in process, project, and construction engineering for the oil refining, natural gas, and petrochemical industries.

The entire organization has been working together for the past 5 years in a previous connection where they handled complete processing, detailed design and construction for several important installations.

The executive staff consists of C. F. Tears, president; Don Horridge, vice president in charge of mechanical design; C. Frederick Tears, Jr., vice president in charge of process and project engineering, and G. A. Woods, vice president in charge of construction.

Tears Engineers is presently handling the extension to the Moose Jaw, Sask., Canada, refinery for British-American Oil Co., Ltd., which consists of a fluid catalytic cracking unit, gas concentration, poly plant, coking unit, expansion of an existing crude unit and off-site facilities. The extension doubles existing refinery capacity with a balanced operation based on the new catalytic cracking unit. They are also doing the engineering design on the extension of fueling facilities for U. S. Army Engineers at Carswell Air Base, Fort Worth.

The firm is also handling complete design work for Sun Oil Co. on several extensions and additions to its Marcus Hook, Pa., refinery as a part of Sun's recently announced expansion program.

Culbertson Improves Houston Plant

This huge sign towers above the Syd E. Culbertson Co., Inc., plant at Houston. The sign is 40 ft. high and has two 28-ft. horizontal sections covering both approaches to the plant. Culbertson facilities for sales and handling of pipe for the petroleum industry covers about 45 acres. The plant also includes facilities for storage, coating and wrapping, pipe cleaning, beveling and welding, hydrostatically testing, and threading to A.P.I. specifications.

Union Wire Appointment

GREGG STOCK

Union Wire Rope Corp. announces the appointment of Gregg Stock as a representative working out of the Union Wire Houston branch under R. O. Tuxson, district manager. Stock is representing the company in the southern part of Texas. He is a graduate of Kansas University.

General Motors Plans Expansion Program

A $1,000,000 - building - expansion program to increase production facilities of the Detroit Diesel Engine Division of General Motors has been announced by W. T. Crowe, general manager.

The announcement highlights a production figure of over 50,000,000 hp. in 2-cycle diesel engines attained by the division since 1938.

According to Crowe, this is the eighth major expansion the division has made and adds almost 80,000 sq. ft. to the 1,000,000 sq. ft. now under cover.

Field Organization Changes Are Made by Schlumberger

H. W. TRUE

Schlumberger Well Surveying Corp. has announced the following changes in its field organization:

F. P. Kokesh, division manager of the Mississippi division, is transferring to the engineering department in Houston, and being replaced in Jackson, Miss., by H. W. True. True was formerly district manager in Houston.

W. J. Lytle has been appointed manager of the Permian basin division. He replaces A. Morazzani, who recently transferred to Indiana as manager of the company's northeast area.

R. L. Morris is transferring to Houston from Lafayette, La., to become administrative assistant to J. de Menil, president of the Affiliated South American Schlumberger companies.

W. W. Goode will replace Morris as division manager of the Louisiana Gulf Coast division in Lafayette.

Lytle, Morris, and Kokesh are all long time members of the Schlumberger organization. All three were employed in 1937 and have worked in many oil provinces in the United States.

HOMCO Establishes New Louisiana Offices

Houston Oil Field Material Co., Inc., announces the opening of new offices in New Orleans. These new

(Continued on page 384)

Your MARKET PLACE FOR THE OIL AND GAS INDUSTRY...

CLASSIFIED ADVERTISING

DISPLAY CLASSIFIED
$12.00 a column inch one issue . . .
10% Discount three or more issues.

UNDISPLAYED CLASSIFIED 12c a word one issue. 10% Discount three or more issues. $3.00 minimum charge. Blind Box in our care counts nine words. Payable in Advance.

EQUIPMENT FOR SALE

FOR SALE: 2 Sullivan 37 Special rigs mounted on International trucks, Waukesha and Buda drill motors. 1700 ft. Sullivan 2⅞ tool joint drill pipe 20 ft. one 800 gallon water tank mounted on late model Chevrolet truck. Two four wheel rod trailers, two 260 gallon gasoline trailers. Equipment in top shape, used less than two years. Nothing additional needed to start drilling. Will sell any part separately except drill pipe. TRANS-TEX EXPLORATION CO., Box 558, Abilene, Texas. Phones 2-7565—4-8130.

FOR SALE: 3—40 hp. 2 cycle Superior gas engines and 3—OCS countershaft reversible clutches complete with V belts. All in first-class condition. Solar Oil Corporation, 1117 Union National Bank Bldg., Wichita, Kansas.

NEW CASING COUPLINGS

(Immediate Delivery)

569—5½" N-80
799—5½" J-55 Long T&C
829—5½" J-55 Short T&C

All Seamless API, 8 rd. thread. Located Dallas, Texas, and Tulsa, Okla.

MID-STATES PIPE & SUPPLY CO.
Ph. 2-9128 Tulsa, Okla.

FOR SALE

OIL WELL CASING AND TUBING

3000' New J-55 8⅝" O.D., 24#, 8 R.T., R.1

Package:
(2500' #1 Used (like new) 2⅜" O.D. 4.70# Seamless upset, 8 R.T., R.2)
(3000' #1 Used 2⅜" O.D., 4.70# Seamless 10 V.T., R.2)
(2900' #1 Used 2⅜" O.D., 6.50# 10 V.T., R.2)

4000' #1 Used H-40 5½" O.D., 14# 8 R.T., R.1 & 2

3800' #1 Used 7" O.D., 17# & 20#, L.W.

MICHIGAN CARLON PIPE COMPANY
20050 Livernois Ave., Detroit 21, Mich.
Diamond 1-1400

NEW STEEL PIPE AND TUBING

4" OD—12 gauge wall
Asphalt coated
Electric Weld
40 foot lengths

3,000 feet
26" OD—281 wall
Electric Weld
40 foot lengths
Write—Wire—Phone

SONKIN CALAMBA

X-772

EQUIPMENT FOR SALE

USED ROTARY AND CABLE TOOL DRILLING TOOLS, WIRE LINES, E. A. KELLY, BOX 861, OKLAHOMA CITY. PHONE 5-6407

FOR SALE: Seamless casing and tubing new and second hand. Phone Rogers Pipe and Supply Co., Tulsa, Okla.

Complete Drilling Rig FOR SALE

Unit rig model 15, two strings of drill pipe, Jack Knife derrick, etc., excellent condition. For further information write

PREMIER WELL SERVICE, INC.
840 Esperson Bldg., Houston, Tex.

NO. 1 USED SEAMLESS CASING

Approximately 75,000' 5½" o.d., 14 lb., 15.5 lb. and 17 lb., 8 round range 2.

A.P.I. NEW & USED TUBING

Approximately 30,000' 3½" o.d., 9.20 lb. A.P.I. 10 round, range 2, regular tubing used.

Approximately 13,000' 2⅞" o.d., 6.40 lb., A.P.I. 10 round, range 2, regular Tubing new.

FRANK MORRIS & CO.
424 So. Cheyenne Tulsa, Oklahoma
Phone 2-6248

EQUIPMENT FOR SALE

502 FEET 10-inch seamless casing, like new, 40 pound, 8 V threads. Near Tulsa. 1208 E. 20th St., Tulsa. Phone 3-9232.

FOR SALE:
USED ELECTRIC POWER PLANT

2 Type G.A.W. Cooper-Bessemer Engines size 12½ x 15; 150 HP. Serial 40673 & 40674.

2 AC Generators 125 KW, 480 volt, 3 phase, 60 cycle, 900 rpm. Allis-Chalmers. Serial 91210 K 51 DE 21-1 & 2.

Plant complete with coolers, exciters, water pumps, tanks, switch boards and a 32 ft. by 36 ft. house, studding covered by corregated metal siding.
Cost $31,000—priced at $15,000.

Located on Summit Oil & Nat'l. Gas Corp. Kagy Lease in Tonti Pool, 1½ miles Northwest of Salem, Ill. Can be inspected without appointment.

Inquire Wm. Peters, on lease, Box 239, Salem, Ill., or L. A. Mylius, Box 264, Centralia, Ill.

BUY NOW FOR IMMEDIATE DELIVERY!
EXCELLENT GAS OR FLOW LINE PIPE!

ONCE USED SEAMLESS TUBING—HYDROSTATICALLY TESTED TO 1,000# P.S.I., THOROUGHLY RECONDITIONED, ENDS CUT READY FOR WELDING, GOOD AS NEW FOR ALL PURPOSES:

125,000'	1¼" O.D. x .135" Wall	1.62#	14' Lengths and Over.
40,000'	2" O.D. x .140" Wall	2.70#	14' Lengths and Over.
90,000'	2¼" O.D. x .120" Wall	3.20#	14' Lengths and Over.
15,000'	3" O.D. x .150" Wall	4.06#	14' Lengths and Over.
20,000'	3¼" O.D. x .135" Wall	4.49#	14' Lengths and Over.
50,000'	3½" O.D. x .135" Wall	4.85#	14' Lengths and Over.
80,000'	4" O.D. x .150" Wall	6.17#	14' Lengths and Over.

UNUSED STEEL TUBING, PLAIN ENDS:

40,000'	3" O.D. x .200/.270" Wall SMLS.	7.3#	18'-30' Lgths.
60,000'	3" O.D. x .270/.350" Wall SMLS.	8.9#	20'-40' Lgths.
75,000'	4" O.D. x .165" Wall ELECTRIC WELD		15'-22' Lgths.

STANDARD BLACK LINE PIPE, PLAIN ENDS:

100,000'	6" (6⅝" O.D. x .280" Wall)	18.97#	Recond. Good Grade, 16'-22' Lengths.
50,000'	8" (8⅝" O.D. x .277" Wall)	24.69#	Recond. Good Grade, 16'-22' Lengths.

OTHER SIZES NEW AND USED CASING, TUBING, LINE PIPE & SEAMLESS TUBING

FOR FULL DETAILS, WIRE OR PHONE AT ONCE

A. J. STRUBEL, Broker

SIDney 1781 (Day Phone) HUDson 8152 (Night Phone) 4946 Murdoch, St. Louis, Mo.

EQUIPMENT FOR SALE

PIPE
ALL SIZES; LINE PIPE AND CASING, TANKS, AND OILFIELD SUPPLIES. EDCO PIPE & SUPPLY CO., PHONES 933 OR 1200, DRUMRIGHT, OKLA.

FOR SALE: Fred E. Cooper-Allis-Chalmers Model W Double Drum Skid Well Servicing Machine. First-class condition, equipped with Drum Dividers, Starting Equipment and Mast Frames but no Mast. Write or call Buckeye Supply Company, Zanesville, Ohio.

SPUDDERS, BUCYRUS, Wichita, Fort Worth, also rotaries and core drills. Good used equipment, tools, pipe, cable. Everything for well drilling. Fishing tools rented. Pressey & Son, Pueblo, Colorado.

FOR SALE: One super model Wilson single drum servicing unit, 80 hp. Waukesha, 4,000' wire, all tubing tools, mounted on GM 4-wheel drive truck. $3500. Phone Rogers Pipe and Supply Co., Tulsa, Okla.

FOR SALE: About 6,000 ft. 4½"—16.60# S.H. drill pipe. Fair condition, $1.25 per ft. Phone Altus Drilling Co., Oklahoma City, 3-2331.

KEYSTONE spudder, trailer mounted, truck and tools. Located Washington County, Oklahoma. Working on seven hundred foot well. Box E-385, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: Miscellaneous used well materials, flow beans, valves, meters, fittings, check valves, etc. All Series 30. Write for list. Michigan Gas Storage Company, Consumers Power Company Building, Jackson, Michigan.

FOR SALE

Model M Wichita Spudder (2000 ft.), with Waukesha motor and complete tools, lines, winch, truck and Caterpillar tractor.

P.O. BOX 1098, or PHONE 1432
Shawnee, Okla.

All Used Good Operating Condition

Byron Jackson #460 Triplex Rotary Hook.

McKissick Fig. 482, 48 x 30 traveling block, National Ideal type L Swivel.

Ideal, type D 6 traveling block and rotary connector.

Conrad Jr. line scale 180,000 lb. capacity.

Byron Jackson weldless Elevator Links 2¼" x 72".

2800' 4½" drill pipe.

Mud Pump Unit, Engine, Cummins Diesel Model LI 600, 7" x 10".

National Ideal Pump Model C 150, 6¾" x 12".

Wagner & Wyant Drilling Co.
708 First National Bank Bldg.
Amarillo, Texas. Phone 3-9574.

EQUIPMENT FOR SALE

FOR SALE: New seamless drill pipe, 6700' 3½" OD 13.30# external upset range 1 & 2 Seal Grip and Shrink Grip threads; 2500' 4½" OD 16.60# internal upset range 1 Shrink Grip threads. Box E-380, The Oil and Gas Journal, Tulsa, Oklahoma.

BETHLEHEM 50 draw works with 145 G.K.U. engine and torque converter, 94 foot mast with substructure C-150 pump and engine, rotary, swivel and 3,550 foot 3½ inch drill pipe, complete rig now working, $25,000. Model E.C. Cardwell draw works with 2 W.A.K.U. engines, 94 foot Lee C. Moore mast with 6 foot substructure, 60 ton swivel and set B. J. Wilson tongs. Rig now working. Lot $32,500. All the above material located in Central Texas. Norvell-Wilder Supply Company, Box 2178, Houston, Texas. At-3471.

FOR SALE—Two (2) Horizontal Steel Tanks, 10½' dia. x 37' long; riveted seams; shell ⅜" thick, dished heads ⅜"; 22000 gallon capacity; 50 psi. working pressure; gasoline storage; good condition, located West Texas. Price $1,100.00. Contact Kinslow Power & Equipment, Inc., 817 So. Boulder, Tulsa, Oklahoma.

COOLING TOWER PUMP FOR SALE: One Wheeler 6" single stage Centrifugal; 1100 GPM at 60' head pressure; direct connected on cast iron base with dual drive; one (1) 25 HP G.E. electric motor and one (1) 25 HP Curtis Steam Turbine. Kinslow Power & Equip., Inc., 817 So. Boulder, Tulsa, Oklahoma.

BOILERS FOR SALE: Three (3) Code Oil Field Boilers: Two 90 HP "Kewanee," 200# WP; one 110 HP "Oilwell Supply," 200# WP. Operated into 1951 under Maryland Casualty Insurance. Good operating condition. Located Tulsa, Oklahoma. Offered subject to prior sale at $900.00 each F.O.B. Contact Kinslow Power & Equipment, Inc., 817 S. Boulder, Tulsa, Oklahoma.

Gaso Duplex 4½" x 6" Power Pumps with Chrysler C-36 Engines, skid mounted. immediate delivery. Also Byron Jackson, Carter Centrifugal Units. Westinghouse 20-25-50 KW Generating Units

H. H. COFFIELD
Attn.: W. H. ORR
Phones: 132—Rockdale, Texas
AT-3427—Houston, Texas

25,000 feet NEW SEAMLESS TUBING

4" O.D. — 12 gauge wall
Asphalt coated
40 foot lengths

Write — Wire — Phone

SONKEN-GALAMBA CORP.

2nd and Riverview (X-767)
Kansas City 18, Kansas
THatcher 9243

EQUIPMENT FOR SALE

FOR SALE: U-15 rotary rig in first-class condition. Has 3 NKU Waukesha motors with less than 1 year service. Without mast or drill pipe. $80,000.00. Will consider good 4000 ft. rotary as part payment. Box E-266, The Oil and Gas Journal, Tulsa, Okla.

FOR SALE: 30,000' of 4½" API Full Hole and Extra Hole Drill Pipe. Joints measure 5¾" to 6" OD. PHIL. A. CORNELL & CO., Oklahoma City, Oklahoma.

ONE MUSKOGEE heavy duty single drum, rod, tubing and bailing unit. Skid mounted. A-1 condition. Harry Mach, Phone 62-6143 or 9-4746. Oklahoma City, Oklahoma

FOR SALE: Ideal slush pump, Model C-150. Melton Supply Company, Seminole, Oklahoma.

WICHITA FALLS Spudder No. 61 complete with tools 16 inch to 5½ with shear polls and half track for moving. New Allis-Chalmers power unit, all in first class shape and ready to drill. Located in Western Canada. Box E-392, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: Cardwell L draw works with air operated Twin Disc clutches, transmission, GAK Waukesha. Good condition. CLAYPOOL DRILLING COMPANY, St. Elmo, Illinois.

FOR SALE erected in Chase, Kansas, area: Two American Steel API Angle Iron Derricks with crown blocks, 333,000# Capacity. Cities Service Oil Company—Patridge, Bartlesville, Oklahoma.

FOR SALE: One Bucyrus-Erie 36 L Spudder three and one-half years old. Complete top to bottom tools 15½ to 5½. Also complete tailing in tools. All in first-class condition. List on request. J. E. Griggs, 310 East Third St., Mt. Carmel, Illinois. Phone 939.

PIPE LINERS—3800 6" Short Dresser Couplings w/ Bolts Less Rubbers and 5000—4" Victaulic Couplings w/ Bolts Less Rubbers All For Sale by Printy Pipe & Supply, Cut Bank, Montana.

FORT WORTH Model-D Spudder, tools for large diameter holes, 2289' 10¾" 40.50# P.E. and 925' 12¾" 49.56# P.E. all seamless new line pipe. Cash, no trade. Contact Aycock, or Andrews, El Fidel Courts, Espanola, N. M.

FOR SALE: 71 Speed Star complete with handtools and drilling tools except 5" bits and 5" wrenches; also house and floor, light plant, and tool box. $4500. Joseph Rush, Otsego, Mich.

1 NEW UD-9 International Power Unit. Big discount. This unit never used. 10,000' 2" galvanized pipe, T&C. Sutcliffe Pipe & Supply, Chanute, Kans., Pho. 1644.

FOR SALE: 3000' 24 lb. and 2000' 20 lb., lap weld casing. Good body. All good threads & couplings. Take all @ $1.75. M. J. Regan, Coffeyville, Kans.

WANT EQUIPMENT: Did you find the equipment you wish to purchase in this column? If not, use an "Equipment Wanted" classified advertisement to find it. It is available somewhere and Journal classified advertisements will find it. See box heading for classified rates, or write The Oil and Gas Journal.

EQUIPMENT WANTED

WE BUY drilling equipment, machines, cable tools, pipe, etc. Turn your surplus equipment into cash. Pressey & Son, Pueblo, Colorado.

TRADE WANTED FOR ANY QUANTITY!

1) 6" NEW STANDARD PIPE
2) 5½" O.D. OR 7" O.D. USED OR NEW SEAMLESS CASING
3) 2" AND 2½" USED OR NEW UPSET TUBING

FOR

EQUAL TONNAGE OF 4" NEW STEEL LINE PIPE

WIRE OR PHONE COLLECT

A. J. STRUBEL, BROKER

4946 Murdoch
St. Louis, Mo.
SIdney 1791 (Day Phone)
HUdson 8152 (Night Phone)

CASING—TUBING—LINE-PIPE

15,000' of 4½" OD, R-2, used SS drill pipe casing, new 8 rd. thrds., and new J-55 regular casing couplings, hydrostatically tested 2500#.

2,000' of 5½" OD, 14#, 10V thrd., R-2, used SS casing.

5,000' of 2⅜" OD, 4.60#, 11½ V thrd., 25' lengths, regular used SS tubing.

5,000' of 2⅜" OD, 4.70#, 10 V thrd., EUE, R-2, used SS tubing.

4,100' of 2⅞" OD, 6.50#, 8 rd. thrd., EUE, R-2, used SS tubing.

100,000' of 4½" OD, 0.188" wall, DRL, 1800# test, PE, new electric weld line pipe.

5,000' of 2⅞" OD, PE or T&C, R-1, used SS tubing.

BROWN PIPE & MACHINERY COMPANY

P. O. Box 2368, Phone 3-9391, Corpus Christi, Texas

EQUIPMENT WANTED

WANTED: Complete set of used seismic recording equipment. Must be type generally acceptable to industry in A-1 condition and ready for immediate field operation. Box E-369, The Oil and Gas Journal, Tulsa, Oklahoma.

NEW OR USED 1500' Range 1, 1500' Range 2 2⅞" drill pipe with Hughes extra hole tool joints, Slips for 13⅛" table, also Webb Wilson tongs and other tools for 2⅞" drill pipe. American Drilling Company, 617 Court Building, Evansville, Indiana.

EQUIPMENT NOT IN USE: Did you find a buyer in this column for the equipment you have for sale. Someone wants it and an "Equipment For Sale" classified advertisement in the Journal will find a buyer. See box heading for classified rates or write The Oil and Gas Journal.

NEW

8⅝" and 10"

A.P.I. 8 Rd. Thread

Regular Casing Collars

WILL SWAP FOR:

7⅝", 11¾" and 13⅜" O.D.

New long or regular 8

Rd. Thrd. Casing Collars

On Pound-for-Pound Basis

Call, Wire or Write

Centralia Pipe & Supply Co.

Phone 6771

218 W. Calumet Centralia, Ill.

HELP WANTED

PROCESS ENGINEERS
Seniors and Juniors

Major Petroleum Refinery Engineering Company Located in New York City desires to expand its Process Engineering Department. Excellent Opportunities for men with Oil Refinery or Chemical Plant Process Engineering experience. Also require several recent Chemical Engineering grads of high scholastic standing. Submit Experience Resume in detail and Past Earnings Record.

Box E-393, The Oil and Gas Journal, Tulsa, Oklahoma

WANTED - ENGINEERS
For WORK in TULSA, OKLA.

Squad Leaders and Draftsmen
Instrumentation
Mechanical Design
Structural
Piping
Electrical
Plant Layout

Contact Chemical Plant Division of

BLAW-KNOX CONSTRUCTION CO.
P.O. Box 1264, Telephone 54-3327
Tulsa, Oklahoma

HELP WANTED

INDUSTRIAL Relations Director for middle west corporation. Must have successful record of handling difficult personnel problems honestly, tactfully. Salary in keeping with high level ability required. Application form and particulars on request. Box E-382, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED IMMEDIATELY: Drilling Contractor for Central Pennsylvania to drill one 8,500-foot Oriskany well and ten shallow 2,000-foot wells. Future very great in these new gas fields. Will back and equip ambitious, competent driller who is a pusher. Contact immediately Winner & Murphy, 218 E. Water St., Lock Haven, Pa.

WANTED
Research and Development Engineer capable of taking charge of department with Oil Field Equipment Manufacturer. Reply giving complete resume stating age, education, experience, positions held, and salary expected. All replies confidential. Box E-346, The Oil and Gas Journal, Tulsa, Oklahoma

WANT college graduate chemist to manage asphalt laboratory for West Coast manufacturer of petroleum products. Box E-362, The Oil and Gas Journal, Tulsa, Oklahoma.

WEST COAST Independent refinery wants superintendent. Desire a man with college technical education and one who has had experience in asphalt. Top job for right man. Box E-363, The Oil and Gas Journal, Tulsa, Oklahoma.

ENGINEERS, Executives, Technical Men. Salaried positions—$3600 to $30,000. This confidential service for outstanding men who desire a change of connection. Will develop and conduct preliminary negotiations without risk to present position. Send name and address for details. Tomsett Associates, 334 Frick Bldg., Pittsburgh 19, Pa.

HOUSTON OPPORTUNITY

Experienced pipe salesman familiar with Houston area to develop sales contacts among Oil Country trade as well as Industrial, by well established local Independent Distributor. Write briefly, background experience, references and age. Good starting salary, excellent opportunity for producer. Box E-372, The Oil and Gas Journal, Tulsa, Okla.

SALES ENGINEER

Engineer with production experience, or experienced production man with engineering knowledge to sell and service reputable lines gas regulators, liquid meters, gas-lift equipment, with headquarters Lake Charles, or New Iberia, La. Also new opening new headquarters in Beaumont. Must be over 26 years of age, personality and appearance for sales work. Salary and commission. Automobile furnished. Please furnish detailed experience and minimum salary. **Box E-383, The Oil and Gas Journal, Tulsa, Oklahoma.**

STRUCTURAL DESIGNER WANTED

C. E. graduate major in structural design with 3 to 5 years experience in design of steel and reinforced concrete structures and in general drafting room procedures. Experience in structural design in oil refinery or chemical industry desired. Location Chicago.

Salary up to $7200

Box E-386

THE OIL AND GAS JOURNAL
Tulsa, Okla.

HELP WANTED

WANTED: Process Engineer who has had at least five years refinery experience. Box E-367, The Oil and Gas Journal, Tulsa, Okla.

KEY Seismograph Personnel Needed by Established and Expanding Seismograph Company. Box E-364, The Oil and Gas Journal, Tulsa, Oklahoma.

REFINERY ENGINEER: Minimum 3 to 5 years' experience in refinery maintenance, construction and operation, to act as Chief Engineer of substantial Mid-western independent refining company, now undertaking installation of catalytic cracking unit. Write: Box E-375, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED: Petroleum or Mechanical Engineers for oil tool design. Field experience desirable. State age, education, experience and salary expected. Box E-319, The Oil and Gas Journal, Tulsa, Oklahoma.

MAN to act as field superintendent for rotary and cable tool rigs. Real opportunity for man who can handle. Position is permanent. Write Box E-371, The Oil and Gas Journal, Tulsa, Oklahoma, giving age, experience, starting salary expected.

WANTED: SUPERVISOR

Large, well-established, rapidly-growing concern is seeking an experienced man capable of assuming full responsibility for setting up and supervising salvage operations on abandoned oil wells in Ohio and Michigan. This is a permanent position with attractive salary-bonus arrangement and a real future for man selected. Please submit complete resume covering experience and qualifications. Box E-389, The Oil and Gas Journal, Tulsa, Oklahoma.

OIL Industry Employment Service, 405 Tuloma Building, Tulsa, Okla. Tom Robinson, owner. Phone 4-5974. For technical and trained oil industry personnel. Employer pays our fee.

THE POSITION YOU WANT: Oil industry companies are looking for men to fill every conceivable kind of position. If you didn't find the position in this column that you are looking for, use a "Situation Wanted" classified advertisement to state your qualifications. Some company is probably looking for your ability. See box heading for classified rates or write The Oil and Gas Journal.

SITUATIONS WANTED

WANTED: Accountant-office manager position in Oklahoma City with independent. OU grad., 34. Experienced all phases accounting. Write P. O. Box 1162, or Phone 58-5756, Oklahoma City.

FORMER Independent Oil Operator ten years, with legal education, plus eight years Wall Street experience, desires connection raise funds exploratory well drilling from excess profits taxpayers. Box D-938, The Oil and Gas Journal, Tulsa, Oklahoma.

DESIRE permanent connection with progressive company in Foreign or States. Have had 20 years practical experience in Gas, Natural Gasoline, L.P.G., Refining, and Crude Oil Production. Excellent References. Age 40, married, two dependents. Box E-388, The Oil and Gas Journal, Tulsa, Okla.

DISTRICT Representative and Sales Engineer and trouble shooter of Oilfield Equipment. API-ASME Degree. Married, 31, family. Desire immediate change in Midland-Odessa area. 12 yrs. experience. References G. W. Harmon, 1302 W. Washington, Midland, Texas.

ATTENTION: Well established oil well drilling contractor desires to manage and supervise: Individuals', groups', small or medium-sized oil companies' drilling, production and operating problems in Central and Western Texas, and New Mexico. Personal interview by appointment is desired. Makin Drilling Company, Box No. 131, Ph. No. 131, Hobbs, New Mexico.

GEOLOGIST

Presently employed. Twenty-five years experience subsurface geology and well completions. Interested in proposition from strong active independent.

Box E-377, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

GEOLOGIST with years of domestic and foreign surface and subsurface experience desires position with an aggressive exploration or progressive independent company in the Rocky Mountain Area. Box E-384, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER, age 30, married, experienced production, drilling, completion, workover, etc. in West Texas, West Central Texas, and Gulf Coast. Desires connection with aggressive independent. Box E-391, The Oil and Gas Journal, Tulsa, Oklahoma.

EXPERIENCED EXECUTIVE
ADMINISTRATIVE ASSISTANT
GRADUATE PETROLEUM ENGINEER, 39 years of age, 18 years experience covering Planning, Engineering and Administrative assignments in the Drilling, Producing and Pipeline Divisions of the Oil Industry including Purchasing, Inventory, Material Control and Sales Duties. Staff assignment P.A.W. programing materials last war. Presently employed by Industry in Supervisory capacity; desire change, must be permanent, with aggressive and well established Independent Oil or Gas Company. Prefer to locate in Houston. Box E-390, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST 4 years foreign experience in subsurface exploration and development. Available immediately. Box E-339, The Oil and Gas Journal, Tulsa, Oklahoma.

THE RIGHT MAN: Can you fill the position you have open from the qualifications listed in this column. Men are always looking for an opportunity to improve themselves. Use a "Help Wanted" Journal classified advertisement to find the men you need. See box heading for classified rates or write The Oil and Gas Journal.

REAL ESTATE

SPACE IS NEEDED: A Journal display classified advertisement is the quickest way to rent or sell your real estate. In the present period of expansion oil industry firms urgently need the space you have available. If it isn't listed here, you may also find it by stating your needs in these pages. For classified rates see box heading or write The Oil and Gas Journal

FINANCING

YOUR FINANCING PROBLEM can be solved at moderate cost. For details write Box E-241, The Oil and Gas Journal, Tulsa, Oklahoma.

LEGAL BLANKS

BURKHART LEGAL BLANKS since 1908 Oil-Gas (all states), Business, Real Estate, Legal Forms, Leases, Revised With Government Regulations, Commercial Printing. Catalog and Samples on request. Burkhart Printing & Stationery Company, 118 South Cincinnati. Tulsa 3, Oklahoma

BUSINESS OPPORTUNITIES

ATTENTION: THOSE DESIRING TO INVEST IN OIL BUSINESS IN MID-CONTINENT AREA. Highclass Geologist, associated with competent lease man and Drilling and Production Supt., desires to contact parties wishing to invest. We can furnish Geology, take leases, do title work, work out satisfactory drilling deal, drill the well and produce it. Will take interest as compensation. Box E-326, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED: $350,000 for drilling and operating 2,000 B.P.D. Topping and Cracking refinery well located, plenty crude and extra good market. Box E-387, The Oil and Gas Journal, Tulsa, Oklahoma.

WANT
N. Y. EXPORT REPRESENTATION?

Long established and well known oil well equipment manufacturer who has maintained N. Y. export office and sales personnel for many years, is now in a position to handle additional representation in New York for high quality manufacturers of oil equipment items. If you're looking for increased export business, write for further information. All replies held in strict confidence.

Box E-359, The Oil and Gas Journal, Tulsa, Oklahoma

ROYALTIES

GET TOGETHER: Both Capital and Royalties are available. If the investment proposition you want isn't listed in this column, use a Journal classified advertisement to find it. See box heading for classified rates or write The Oil and Gas Journal.

MONTANA ROYALTIES
Millions of acres now leased by world's major companies, with huge drilling play in prospect. For booklet describing Montana geology and oil development, write Landowners Royalty Company, Box 1225, Great Falls, Montana.

PRODUCING ROYALTIES
WANTED
ANY AREA
BERN SECURITIES CO., INC.
111 Broadway New York 6, N.Y.
WOrth 4-7546

LEASE AND DRILLING BLOCKS

WANTED: Oklahoma or North Texas drilling deal with merit. Not over 4500'. Give full details in first letter. Box E-355, The Oil and Gas Journal, Tulsa, Oklahoma

BLOCK of 3600 acres in New Mexico. Geological reports favorable. Correspondence invited from Parties interested in developing this acreage. Zeke Morse, 2525 South Spaulding, Los Angeles, California.

WATER FLOOD PROPERTY AVAILABLE 250 acres, full ⅞ leases, North Central Texas—900' to 1,000' deep. Sand production. 11 wells now producing. Estimated 20 proven undrilled locations. Ample supply salt water available from shallow sand on property. Pipe line connection—Electrically operated. Box E-360, The Oil & Gas Journal, Tulsa, Oklahoma.

WILL pay cash instantly for leases (large blocks), royalties, mineral deeds, production. Write fully—P. O. Box 2153, Denver, Colorado.

FOR SALE: Oil and Gas Leases in shallow territory. If interested in a good development proposition near oil producing wells write or wire W. P. Harley, Bowling Green, Ky.

FOR SALE: Federal and State Oil Leases, Twp. 23 N-5E; Twp. 24 N-5E; Twp. 21 N-5W; Twp. 17N-3W; Twp. 15N-1E; New Mexico P. M. About 255 acres. 10220 Kilarney, Dallas, Texas.

Interested in drilling several wells not over 4000' in North Texas by December 15th. Give complete description and full details, Box 4343, Dallas, Texas.

LEASES ROYALTIES
Producing and Nonproducing
Bought and Sold—Any Area
Inquiries Invited

B. D. BUCKLEY
6635 Delmar Ave., St. Louis 5, Mo.

WANTED

Unitized gas field producing 4-5 million cubic feet gas per day with liquid content 5 gallons per thousand or more. Operator has complete plant ready to move on site.

Contact: NORMAN STRAUSS

BROWN-STRAUSS CORPORATION
P.O. Box 78—HA-1000
KANSAS CITY 10, MISSOURI

LEASE AND DRILLING BLOCKS

LOOKING FOR A LEASE? There will be over 40,000 wells drilled this year. If you are looking for a lease, drilling block, or drilling deal and haven't found it in this column, or if you have a lease or drilling block you want drilled, a Journal classified advertisement can find an interested party. See box heading for classified rates, or write The Oil and Gas Journal.

FOR SALE—MAPS

NORTH DAKOTA MAPS—Base Map of North Dakota: County outline, Township and Range, location of wells and Operators name with total depths. Oil and Gas Fields. 1" = 8 miles. Price $5.00. COUNTY MAPS: Fee ownership and lease with expiration dates. Scale 1" = 4,000 Ft. Northwest Mapping Co., 1171½ Fourth St., Bismarck, North Dakota.

FOR SALE—MAPS

OIL And GAS LEASING ON THE PUBLIC DOMAIN

(By Lewis Edwin Hoffman)

Federal laws, forms, regulations and practices **Each $7.00**

GOWER FEDERAL SERVICE
321 First National Bank Bldg.
Denver, Colorado

EQUIPMENT MEN

(Continued from page 380)

offices will be headquarters for Tom Holland, division manager of Homco services; T. F. Burke, district sales manager, and A. O. Meadows, assistant division sales manager.

Other Homco Louisiana headquarters will be at Harvey, Houma, New Iberia, and Lake Charles.

Spicer Is Oklahoma Sales Representative for Baird

E. E. SPICER

Harold Sheridan, president of Baird Manufacturing Co., Tulsa, recently announced the appointment of E. E. (Spike) Spicer as Oklahoma sales representative for all Baird products.

Well known throughout the Oklahoma and Kansas petroleum area, Spicer was formerly with the Diesel Division of General Motors Corp.

Spicer will devote his time exclusively to the promotion and sale of Baird oil-field production equipment.

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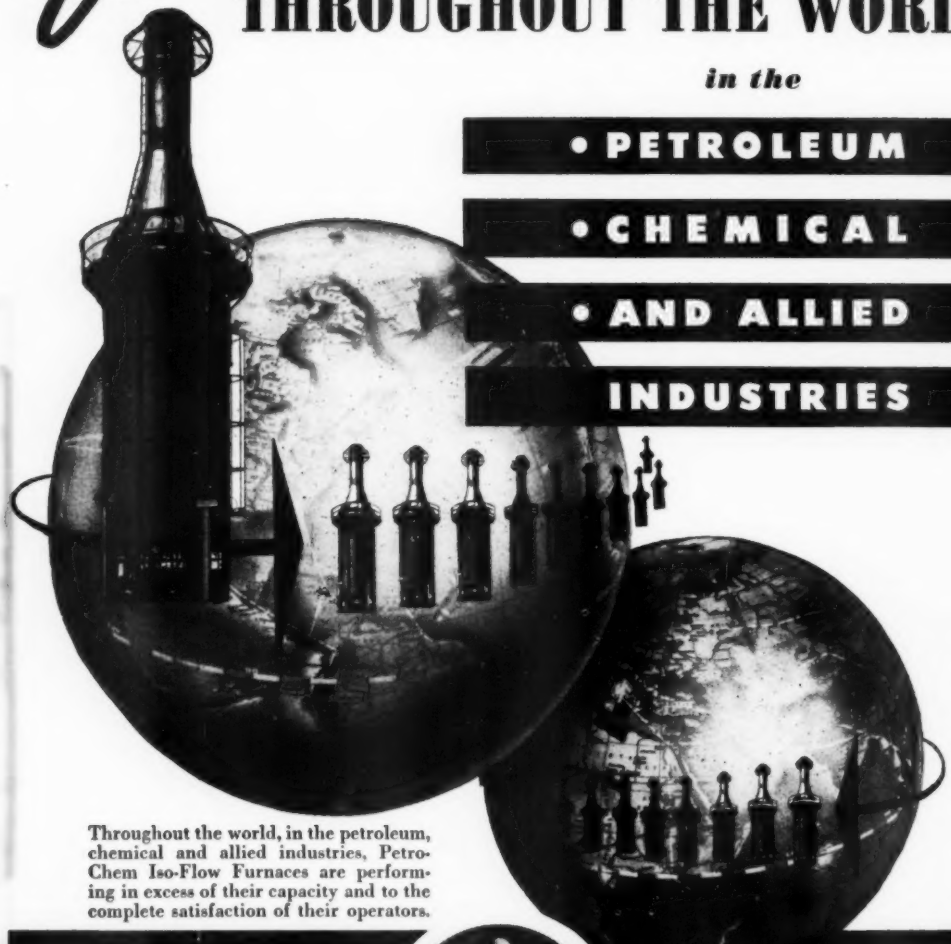

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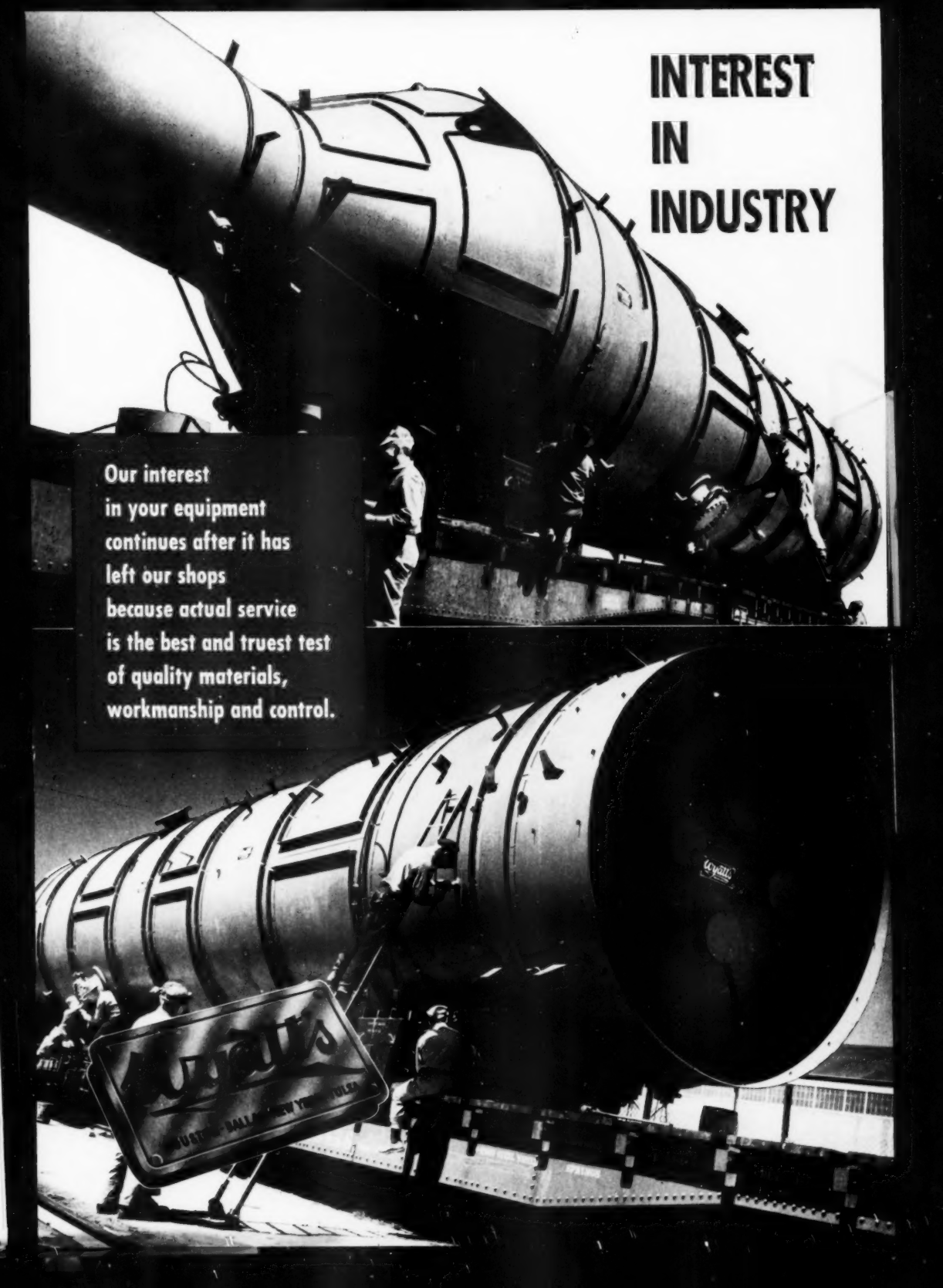
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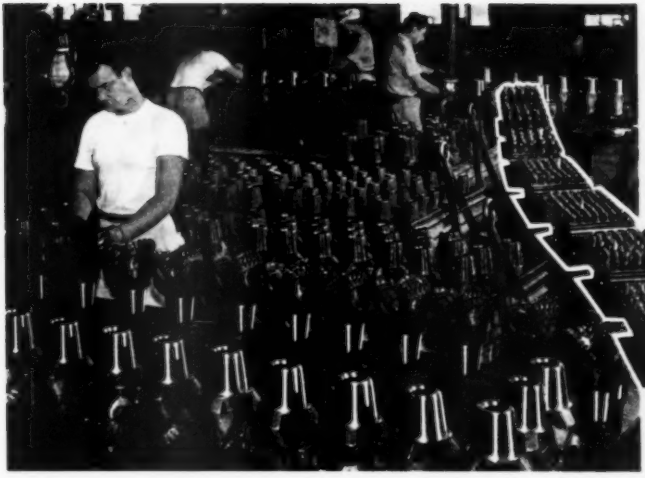

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